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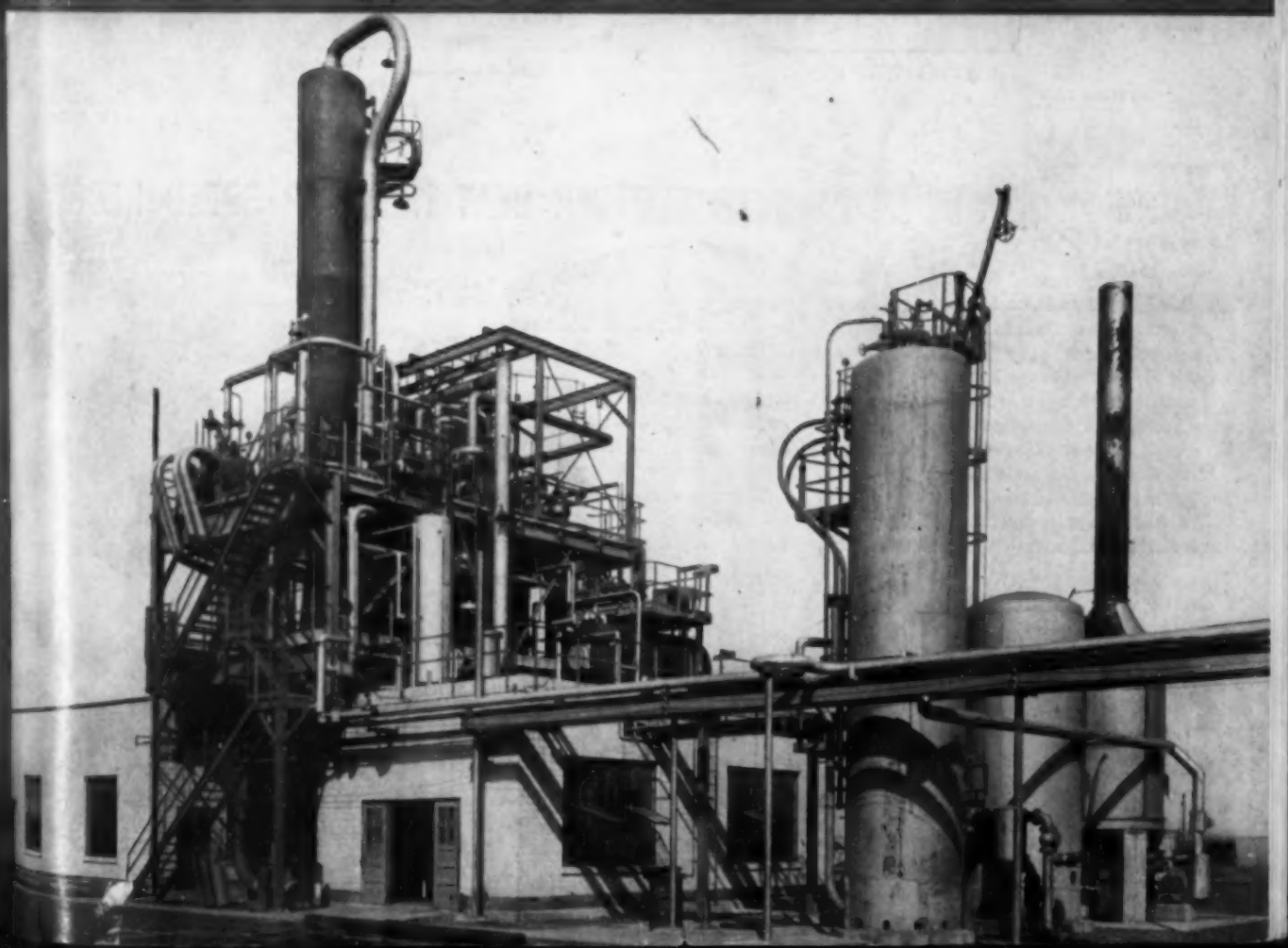

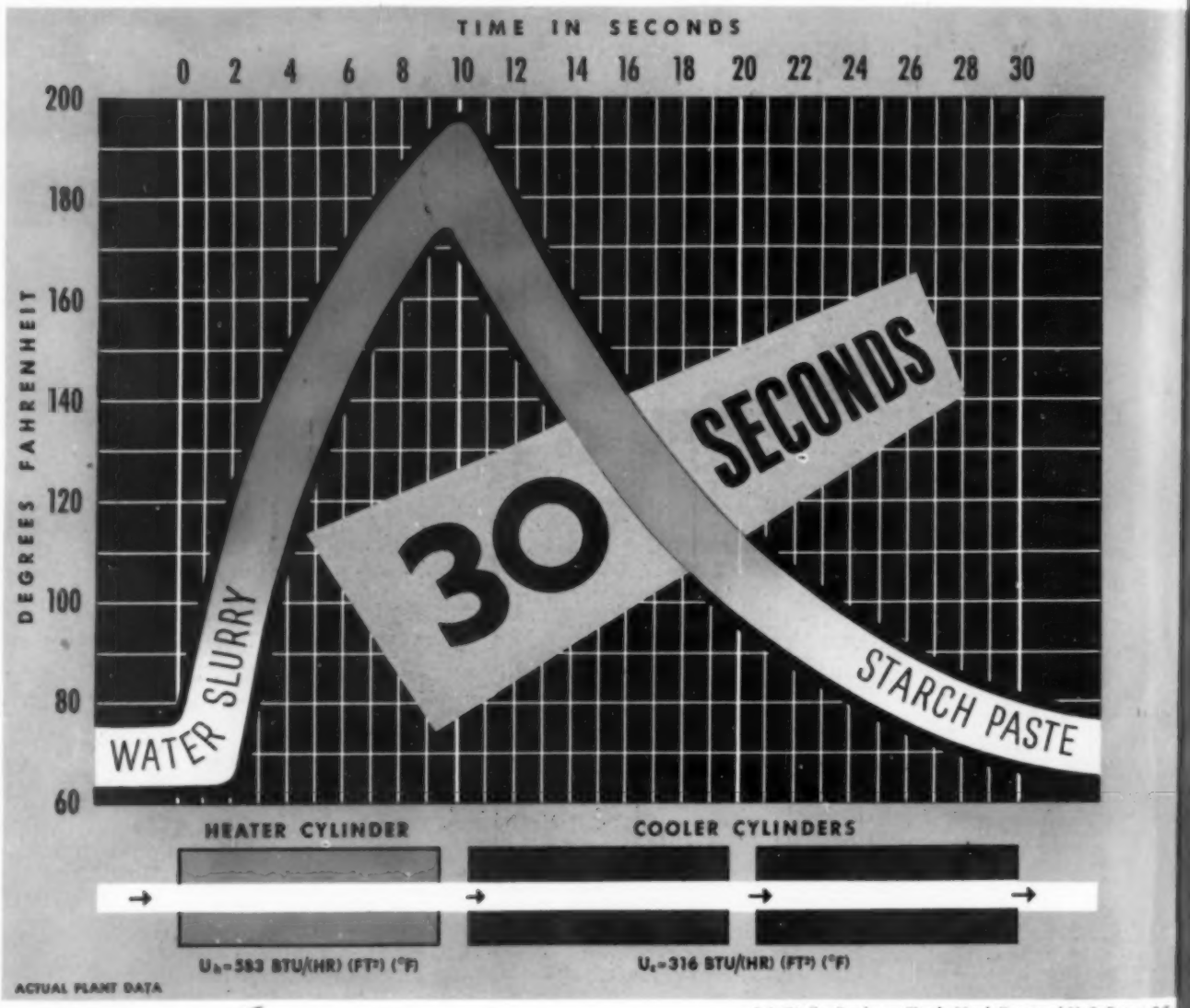

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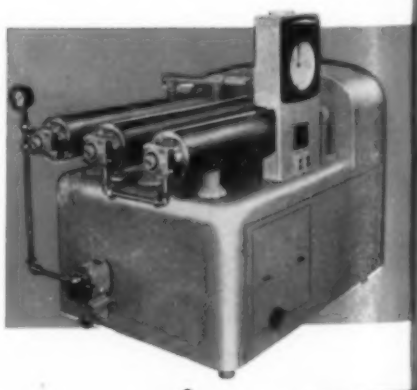

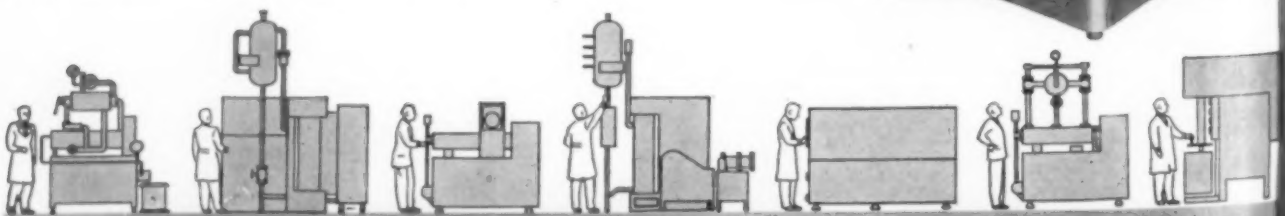

CONTINUOUS, CLOSED HEAT TRANSFER AND PROCESSING EQUIPMENT FOR THE FOOD, PETROLEUM AND CHEMICAL INDUSTRIES

CHEMICAL & Metallurgical ENGINEERING

JULY • 1945

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						Nominal Pipe Size	Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¼"-24"	1"-12"	1"-8"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	1½"-30"				
Elbows	45° Long Radius	½"-30"*	¾"-30"*	1"-12"	1"-8"	4"-24"	3"-12"
Returns	180° Long Radius	½"-24"	1"-24"	1"-12"	3"-8"	4"-24"	3"-12"
Returns	180° Short Radius	1"-30"	1½"-30"				
Returns	180° Extra Long Radius	1"-2½"	1"-2½"				
Tees	Straight	⅜"-24"	¾"-24"	1"-12"	1"-8"		
Tees	Reducing Outlet	⅜"-24"	¾"-24"	¾"-12"	1"-8"		
Reducers	Concentric & Eccentric	1x⅜-24x20	1x⅜-24x20		1x⅜-12x10		
Caps		1"-24"	1"-24"		1"-8"		
Stub Ends	Lap Joint	1"-24"	1"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header	1¼"-12"	1¼"-12"				
Saddles		2"-24"**					
Laterals	Straight	1¼"-24"	1¼"-24"				
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Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Socket Type	¼"-24"	¼"- 4"		¼"-3½"			
Reducing-threaded or slip-on	⅜"-24"	¾"-24"	¾"-24"†	¾"-24"	¾"-24"*	¾"-24"	⅜"-12"
Orifice—threaded		1"-24"	4"-12"	4"-12"	3"-12"	1"-12"	
Orifice—slip-on		1"-24"					
Orifice—welding neck		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Long Welding Neck	1"-24"	1"-24"	1"-10"	1"-10"	1"-10"	1"-10"	

†Dimensions on sizes thru 3½" same as for 600 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

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CHEMICAL
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ESTABLISHED 1902 S. D. KIRKPATRICK, Editor

JULY 1945

Taxation and New Product Development

GRANTED that research makes jobs and that our greatest desire as a nation is to promote high-level employment after the war, it is time that we study and remove any obstacles in the path of new product development. One of these is the effect of federal taxes on research expenditures. Today there is a direct conflict between the tax law and the government's practice in its enforcement. This has resulted in uncertainty and discrimination that are definite deterrents to research. In the opinion of at least one careful student of this situation, remedial legislation is sorely needed.

That need is most clearly seen by Professor J. Keith Butters, of the Harvard Business School, who has just completed a survey as a special advisor to the director of the Office of Scientific Research and Development. Writing in the summer number of the *Harvard Business Review*, he points out that the Treasury regulations, supported by several recent court decisions, apparently require the capitalization of most research expenditures. "By and large," he added, "the Bureau of Internal Revenue in its actual treatment of the handling of research expenditures has been more liberal than the Treasury regulations would indicate and has generally permitted such expenditures to be deducted as current charges against net income."

If a firm spends approximately the same amount on research year after year and consistently claims these expenditures as income deductions, such claims are seldom disallowed. On the other hand, if the amounts fluctuate widely or if the company is inconsistent in its accounting practices, the Bureau is likely to be more critical. This often results in a less favorable treatment for the small company whose needs for research may vary widely from year to year. Conversely it plays into the hands of the large organization that has already established its position and is able to stabilize its research appropriations.

Over a long period of years, the difference between "expensing" and "capitalizing" research expenditures will largely offset each other—provided, of course, that the tax rates do not change materially. But if the tax rates are rising it will increase the advisability of capitalizing research expenditures, while if the rates are declining, it will be desirable to write off such expenses as rapidly as possible. Today we are presumably operating with corporation tax rates at about their peak. Increased research appropriations can largely be covered by savings on taxes. And if we are to have substantially lower taxes in the near future, then a much larger proportion of the profits resulting from such research can be retained. This undoubtedly has been an influence in encouraging increased appropriations in recent months. Today the really limiting factors on research are manpower and materials—rather than money.

Tomorrow, however, we may well be plagued by the uncertainty and discrimination in taxes that are emphasized in Professor Butters' thoughtful article. The remedy, as he points out, is comparatively simple—merely to provide specific legal sanction for the present more liberal practice of the Bureau. His recommendation is that the present Internal Revenue Code should be amended so that the taxpayer has the option: "(1) to deduct currently all expenditures on scientific research and development of new products and processes (other than expenditures for the acquisition of tangible capital assets); or (2) to capitalize such expenditures as deferred charges and amortize them according to a specified plan deemed reasonable by the taxpayer; or (3) to deduct currently designated parts of these expenditures which in the judgment of the taxpayer are current costs and to capitalize the remainder and amortize them according to a specified plan deemed reasonable by the taxpayer."

These proposals are worthy of serious study by engineers and research directors, as well as by the financial and legal experts in our various companies. There has probably never been a more propitious time to remove the uncertainties and inconsistencies that may throttle our future progress in creating postwar employment.

HENRY ROSS *Chemical Engineer, Mythical Chemical Co., New York, N. Y.*

ACCIDENTS
By Any Other Name

Here is a real challenge to chemical management. For reasons that will be obvious the author has preferred to use a nom de plume and not to identify the company with which he is associated. But these facts in no way detract from the splendid manner in which he relates the many cases of men in responsible positions in the industry whom death has struck down in the mid-forties. He wants management to undertake not another safety program, but rather to take steps to put a stop to the identifiable conditions of the jobs which victims found distressing and caused untimely deaths.—*Editors*

IF THE READER is fortunate enough not to have lived such a story as that which follows, it is a near-certainty that he knows someone who has and that his own escape is narrower than he thinks. It is the story of a kind of industrial accident over which to this day Old Lady Luck and no one else is deemed to have inscrutable control, even though it is in industry itself that the techniques of accident prevention have accomplished miracles.

Ironically, it is within the most safety-minded industries that the Old Hag has lately been overplaying her hand, crumpling altogether too many foremen, superintendents, executives and other key men in their mid-forties by any one of a dozen standard forms of organic failure which every victim thought could never come his way—until it did. Hypertension, duodenal ulcer, gall bladder disease, arthritis, and a sheaf of others, many not due to war strain.

The Old Dame laughs. Because such misadventures do not look like accidents; because they are never called accidents; and because they may tap anyone anywhere at any time, most safety departments still think it none of their business. That is what, until recently, everyone thought in the Graustark Division of the Mythical Chemical Co.

Let this, then, be the story of learning the hard way, as that company did, after reaching the pinnacle of success in preventing conventional accidents. That the name is fictitious does not matter. The account of events is actual and exact. Within reason, the reader may substitute almost any other organizational name he might choose, without impairing its run-of-man accuracy.

Mythical Chemical is an old-established concern, not the largest in its field, nor the smallest, but operating on a scale sufficient to have brought about a high degree of departmentalization of its functional activities. The number of men on the Mythical payroll runs close to five figures. The Graustark Division operates in a suburban area where its employees form a close-knit community. The company maintains its own hospital, superbly staffed and equipped for any traumatic eventuality.

Back in 1924, the management, which even before that had given somewhat more than casual attention to accident prevention, became aware that safety is a broad and challenging science, the principles of which are as rigorous as those of chemistry or physics. Thereupon, like many other companies about that time, Mythical undertook an appropriate development of mutual employer-employee self-interest to minimize personal injury in the plant.

A forthright and deeply sincere campaign was initiated from the top, vigorously led and organized with full departmental status. The safety engineer was no longer a lonely man; he now had help and plenty of it. The high-spirited challenge to avoidable mischance from outwardly physical and manifest causes was diffused throughout the organization and caught on infectiously.

In its top supervision, the undertaking became studiously professional, subject to the scientific approach and the experimentally guided procedures of any other technical specialization. As to injured workmen, the easy and ancient platitude that "the damn fool should have known better" was overnight out the window. The buck-passing belief in bad luck or an act of God as an inscrutable cause of accidents ("you get it when your number is up") was effectively reappraised as an act of unlightened man to whom enlightenment might be brought before the critical moment. Management clearly recognized the modern concept that every accident is a management responsibility, quite apart from formal law, tantamount to making sure that the potential victim does know better in good time. If paternalism were involved—and it would be unfair to say it was—it was the irreproachable paternalism of a practical, implemented Golden Rule.

In 1926, the lost-time accident rate was half that of 1925; in 1927, the 1926 rate was cut in half. By 1930, the rate per thousand man-shifts worked was but a tenth of that when the program began—and it had not been bad in 1925. Eventually, in the late 1930's, there was a slip-up as is the purpose of this account to tell.

In the 1930's, the broader aspects of physical well-being were increasingly recognized. Community health, the preventional therapy of community diversions, such as sports and home beautification, a pension arrangement to ease the worry diseases attending financial insecurity, the subtle occupational health hazards due to elements of plant practice were among the subjects of appropriate study and action. First aid training became general and thorough; off the job as well as on, convincing examples of its value became commonplace. Long using trophy techniques as a spur to safety, Mythical itself began winning national recognition and eventually a national safety trophy.

A FRONTIER WAS OVERLOOKED

In other words, after nearly two decades of patient effort, Mythical was all to the good, proud of it, and finally ever so slightly complacent that no further safety frontiers seemed to be left. A larger frontier was overlooked. That's when the trouble began. Stopping, Mythical began to drift backward.

The war years had not yet come on but throughout the nation there was a feeling of brooding uncertainty. Anticipating things to come, management brought in two or three bright young men, calculating against certain department heads approaching retirement age. These young men, whose unquestionable brilliance was beamed in one or two directions, and underdeveloped in others like one of Walter B. Pitkin's brainpower imbalance curves, were placed in positions which earmarked their future. An atmosphere of disgruntlement was soon noticeable among others of long service who suddenly saw dead-ends ahead of them after it was too late to do anything about it.

In a company as large as Mythical, there had always been a record of occasional health failure of key men before their time, but these had always been regarded as irrelevant to plant operations. Even when these now began to increase, they continued for a time to be looked upon as being out of bounds. This was the safety frontier which Mythical overlooked, and which later exacted a heavy dollar penalty.

First there was what appeared to be a very "simple" case. George Brown, head of the shipping department, began to have trouble with the recently promoted production manager. He suddenly broke a life-long abstinence and at 46 became an alcoholic in a matter of months. Rightly or wrongly, but in any event sincerely, he had for some years nursed a resentment toward a policy detail which seemed to him out-moded. No one had ever talked it out with him, but instead always dismissed him brusquely. When the turn came, George went down the skids so precipitately that no one could pull him back before he hit bottom and disintegrated. Indeed, no one tried, but held him in moral censure, not for the company battle but for the private bottle. It had been only a casual but eventually heated conversation with the production manager on a "bad" morning that triggered him off to his first binge. Oddly enough, that policy matter was changed a few years later as a matter of logic and changing conditions, without any thought of George having had any connection with it.

Charlie Smith was another like Brown, though his fate was outwardly different and above normal reproach. Like many of the men in Mythical, Smith lived his job and took it home with him at night, even in peacetime. The community knew that he would one day be vice-president for he was a brilliant and dogged man, though seldom seen at the golf club or the bridge parties. His associates had therefore to exchange their off-the-job jovialities with lesser men, and were dumbfounded when a cerebral hemorrhage finished him off at 47.

Digressing to put the matter in a medically naive light which operating men will nevertheless understand, Charlie's

George Brown had trouble with the recently promoted production manager. He broke a life-long abstinence and at 46 became an alcoholic in a matter of months

plight had a mechanical parallel in the plant. It happens that part of Mythical's business is such that many men in that organization have to know about the scaling up of process lines, and the high gage pressures which such accretions set up in pump circuits. The research department, being alive to its job, had brought about correction of the plant difficulty—an air scrubber ahead of the lime reactors—by making the cause known to those concerned. Actually, no research was required; just the passing on of some textbook information to the right persons. But it was none of the research department's business that the pipe lines which carried Charlie's blood around inside of him were scaling up with cholesterol, as Russian investigators had discovered in the study of such cases. It was not their business to know that Stenberg and his associates had been finding measurable increase in cholesterol level of the blood stream during periods of emotional stress or intensity. Mythical's research department is sprinkled with Ph.D.'s who could—if anyone asked them—detect cholesterol anomalies long before they show up in pressure, for cholesterol is $C_{27}H_{45}OH$ and can be detected and measured readily. No one asked them, for they work as plant process men only. The medical department likewise had no call to explain professionally to Charlie, in advance, the mechanism of either haemodynamic or psychiatric hazard. The company doctors had to wait until Charlie was in visible trouble; until hypertension or hypercholesterolemia had advanced to a point where mere gage pressure became formidable enough to frighten Charlie into a calculating mood, and even then he often forgot to calculate. In the initial pressure anomaly stage, it had been sufficient to tell him, as had been done repeatedly, to ease up. Nevertheless they had no authority to see that he did so, or to describe the situation to him in his own well-understood plant idiom. Had they been private practitioners, they would have had no authority at all. All this hardly squares with the fact that, in the plant, there is plenty of authority to see that even a vice-president does not violate a safety rule.

SAFETY DARK AGES

In other words, Charlie Smith was pushed right back into the safety dark ages of 20 years ago when "the fool should have known better." Even the safety engineers thought so too—if they thought about it at all, this not being their responsibility either. That group had taken no steps to see that his job did not kill him, though doing as much for riggers and cranemen. Preventional psychiatry was at that time still hush-hush at Mythical, too much dynamite in its implications to mention, some thought.

The accident record, of course, remained clear. Deaths from "natural" causes do not count industrially. Mythical experienced some difficulty in developing a successor up to Smith's stature. Such matters, it is too easily said, cannot be statisticalized, but his loss may have cost the management something like a hundred thousand dollars. Like any other company, Mythical works on a dollar basis, but dollars are hard to count in the dark.

Ben Jones, head of the intermediates

department, was a member of the Quarter Century Club. One does not last on a payroll for 25 years without having what it takes; Jones did. He had, in fact, made his one of the finest departments in the country. The officials were proud of him, but took it for granted that he realized the fact without their telling him so. Some

Charlie Smith, seldom seen at the golf club, took his work home with him. A cerebral hemorrhage finished him off at 47

of them occasionally roughened up toward him when their honest opinions were at variance with his honest opinions. A little verbal compensation at other times would have helped, had not false pride and preoccupation prevented. Jones always worried a little, it can be recalled, over the fact that he was never quite at ease with the "brass hats," as he called them, a name which itself suggests the hidden dangers of their cultivated austerity.

Back in school days, he once told a friend, he had stood at the head of his small town class, winning much praise from his own and other parents; that is, from those who were his immediate superiors during the formative period of his life. He spoke of missing that kind of verbal reward in industry when he tried to maintain the corresponding standard of accomplishment, and in some puzzlement too because he attributed the success of his department in part to his own thoughtful use of it among his men. The matter became an obsession with him, which his excellent salary and annual bonus did little to assuage, for dollars had not been the going currency in the years when his achievement pattern was molded. In his own mind, he was psychologically underpaid. From management's viewpoint, he should snap out of it and becon.e an adult. (The fool should know better).

Jones was depressed when word went around that supervision had to be tightened in all departments. He knew that in practice this meant more bossing, and less leadership-by-inspiration-and-understanding. That year, when he was 46, he began developing the outward symptoms of arthritis. The medical department gave him weeks of unstinted and technically polished attention, found no ossification that any X-ray could detect, and signed off his disability as the spastic muscular type induced by inner conflict. He was told that he would recover fully if he would stop worrying, but that otherwise his prospects were not bright. The means of doing that were left to him to discover unaided. The advice defeated the very purpose it was meant to serve, for he found himself hopelessly unable to follow it.

His involuntary nervous system had long since been grooved otherwise and worry was not to be turned off like a spigot. Worrying now about being unable to stop worrying, he faded away to a stiffened shadow. He was retired at 48 in total permanent disability, handsomely covered financially under the retirement and group insurance benefits. Mythical took its loss as a matter of course. The function of seeking to prevent such losses simply did not fit into any of the existing departments of the organization chart. They could see the financial loss, indeed they could see the arthritic condition, but they had not heard the words of Colonel Menninger, chief psychiatrist of the U. S. Army, who recently said that symptoms are developed unconsciously to gain relief, aid, or escape from an intolerable situation; that the neuropsychiatric is just as genuinely disabled as the man with a bullet through his leg or the fellow with a broken arm.

IN A TRAPEZOIDAL HOLE

As a final example, there was Phil Sims, in charge of the electrochemical department. Phil was an artist at heart. His symphony records, his violin, and his garden, all of which he loved, should have provided the therapy to head off any kind of crack-up. Instead, as it turned out, these things had precisely the opposite effect. He was a chemical engineer, only because his father had forced him through engineering school. His reserve talents were sufficient, so that for many years he excelled at his job, as witness his having risen through the organization to department head status. It is insufficient to say that he was a round peg in a square hole; in the complexity of industry he was more nearly an octagonal peg in a trapezoidal hole. His downfall began when a quick-witted young assistant, with a gift for merchandizing his own talents began capitalizing on the little openings around Phil's periphery, or so Phil imagined. Phil was stricken suddenly one day by internal hemorrhage and came out of the hospital some weeks later minus an ulcer and with a sadly maimed duodenum as a further cause for worry. Oddly enough, Phil was an expert on corrosion, but not on the kind of corrosion that emotionally induced HCl might create in his own bread-basket. The assistant, without the remotest conception of any personal guilt, succeeded Phil in running the department thereafter—probably better than Phil by formal measure, although the men grumbled over the change. So far as Mythical was concerned, the causes were at no time equated to some of the incidental but significant job factors involved.

Mythical's specialists are of course well aware of the work of Dr. Joseph B. Cannon and many others concerning the pH of fear reactions, but their corporate assignment was only to break out the cutlery when the situation became critical. Before that, Phil was merely thought of as fighting himself too much, and the responsibility for change a voluntary one of his own. Thus another antiquated case of the fool who should have known better took its melancholy way through the records. Mythical's executives, sensing what was going on, could have caught Phil in time and saved the company a neat sum if, in the worst view, money was the sole measure of their function, but they too were so occupied by their own specialties that they had given no thought to the possibility either.

Altogether, the company has had 11 cases like those described, and many others back through the dimly remembered 1920's and 1930's, when such personal misfortunes were thought to be—of all aboriginal voodoo!—just a species of "hard luck." All were key men, such as foremen, department heads, executives or assistants, and —ironically enough!—two of the doctors, but each with a different outward manifestation, never connected with any of the others nor with the insensibilities of the job. A hyperthyroid here and an ulcer there. A secret insomniac whose final cave-in passed through the stage of habitual sedatives. There was a pernicious anemia case and a semi-orthodox double pneu-

Ben Jones was never quite at ease with the "brass hats", as he called them, a name which itself suggests hidden dangers of their cultivated austerity

monia, both traced circumstantially to accessory conditions accepted as primary, and a miscellany of others, including an encore for cholesterol, this time as gall-stones. Scarcely one was an out-and-out, plain and unadorned nervous breakdown, except perhaps George Brown, the alcoholic.

Such organic failures occur every day in every walk of life, and it would be grossly unfair to cite Mythical as being either unique or culpable. Nevertheless the point should not go unmarked that each one of these 11 men was in some kind of specific trouble or conflict, pertaining invariably in part to business activity, but seldom entirely to business. All were extremely conscientious men, gifted in imagination or drive. Many had come up the hard way. All entertained some off-the-job frustration as well (and who doesn't?) or some ingrown carry-over from childhood, which in diverse ways the job magnified to critical degree. Even the wholly admirable retirement plan set up an adverse element in some cases by blocking a therapeutic change of environment. Every one had worked many years under unchanged and deadening conditions.

WHOSE RESPONSIBILITY

Here in the Mythical organization was a disastrous situation—almost, but not quite, a direct responsibility of the medical department, where resides the skill to judge the signs, but where the insistent techniques of accident-prevention has never won triple-A priority. It is almost, but not quite, a responsibility of the safety department, where, however, the thought is of the effect of machines and industrial operation upon the manifest bodies of men, not on their minds or endocrine balance. It is almost, but not quite, a function of the research department, whose duty is to diffuse knowledge and discovery (their own and others) to those points where the greatest benefit to the balance sheet will accrue. This is unquestionably that kind of a problem but the research staff is composed exclusively of plant and process experts never called upon for researches in accident-prevention, though accident-prevention is clearly a plant process too. It is almost, but not quite, a duty of the personnel department, whose function is to ferret out maladjustment, but only among the workmen rather than among those of upper-bracket standing.

The problem does not run down the organization chart to any one of these, but is tangent to all of them. Management has never drawn in that tangent. In unchallengable virtue, all four of the subdepartments may ignore the problem until such time as management may get out a new organization chart and plug the gap by more than the so-called periodic health check-up.

The method is plain, and indeed was recently described by Dr. Bruno Solby of the U. S. Public Health Service. "The task of the industrial psychiatrist," Dr. Solby said, "is to analyze the difficulties of such employees and get at the real source of the trouble. It is the job of personnel management, supervisor, and industrial psychiatrist to cooperate in fostering the mental health of the group through scientific job placement."

Phil Sims' downfall began when a quick-witted young assistant, with a gift for merchandising his own talents, began capitalizing on the little openings around Phil's periphery

These hidden hazards must be brought out into the open, as traceable, even if only in part, to the exigencies of industrial operation, rather than shushed back into the limbo of inscrutable organic failure or psychiatric tabu.

First they must be quantified, classified, and analyzed, insofar as that is possible, just as conventional accidents have been. Give any industrial executive a figure to watch, and he will see to it that the time-graph of that figure moves in the direction the company's interest demands. No industrial executive, not even the top drawer variety, can stop the calendar and prevent employees from growing older (it is too early to speak of testosterone or other hormone techniques which are indeed purely medical business), but at least he can see to it that organizational procedures and policies do not so often and needlessly roll ten years of the aging process into one or two, as William Benton, vice-president of the University of Chicago recently remarked. Dr. Benton went on to say: "Many of the big corporations tend to operate against the man with imagination and drive. The bigger the crowd, the harder it is to be seen in it. One's superiors are often concerned with promoting themselves or with hanging onto what they've got. Their job is to keep their departments running the way they have always run. The unspoken slogan of many a big business is 'Don't rock the boat.'"

In every case in this company's history, organic failures had elements in them which came from private life and were none of the company's business, but at the same time everyone was tripped off into tragedy by some identifiable condition of the job which the victim found distressing, either in fact or through a quirk in his own imagination. The aggregate hard-money cost of these tragedies was something like a half-million dollars, which came out of the company treasury. The president of Mythical would himself be the first to rise to his feet and shout: "Anything in our practice that costs us a half-million dollars is very much our business. Now you fellows get out there and do something about it." He would understand at once, when brought to his attention, that such hazards are as guardable as an open pulley on a compressor, though he would not send a mechanic to do the job.

One need assess neither blame nor responsibility. This is a trend which has been creeping up so stealthily as to have passed unnoticed as industrialization increases and we move farther and farther away from the good old days on the farm. Back in 1916, the industrial accident victim was the fellow in the lower brackets. Now in 1945, the more costly accidents are in the above-median bracket, but they do not yet go by the name of accident, let alone preventable accident. Using the same proved technique, the time may be ripe again for somebody to teach somebody better.

We may dismiss all this easily by saying it is the result of war strain, though the prewar record does not support that view. In peacetime, intense competition is but a step short of another kind of war of heavy mental strain. "Competition syndrome" may be the peacetime equivalent of "Guadalcanal syndrome," not so severe at any one moment, but having years instead of months for its progress. In addition, there were few men as old as 45 on Guadalcanal.

HUMAN ABRASION IN INDUSTRY

Perhaps Clarence Darrow of all speakers in this context, had the right idea. After 40 years of research on human abrasion in industry, Darrow said: "Nothing in the Universe is outside the law, whether mineral, animal, or vegetable. Man is moved and virtually controlled by every experience in his life. The laws that control human behavior are as fixed and certain as those which control the physical world."

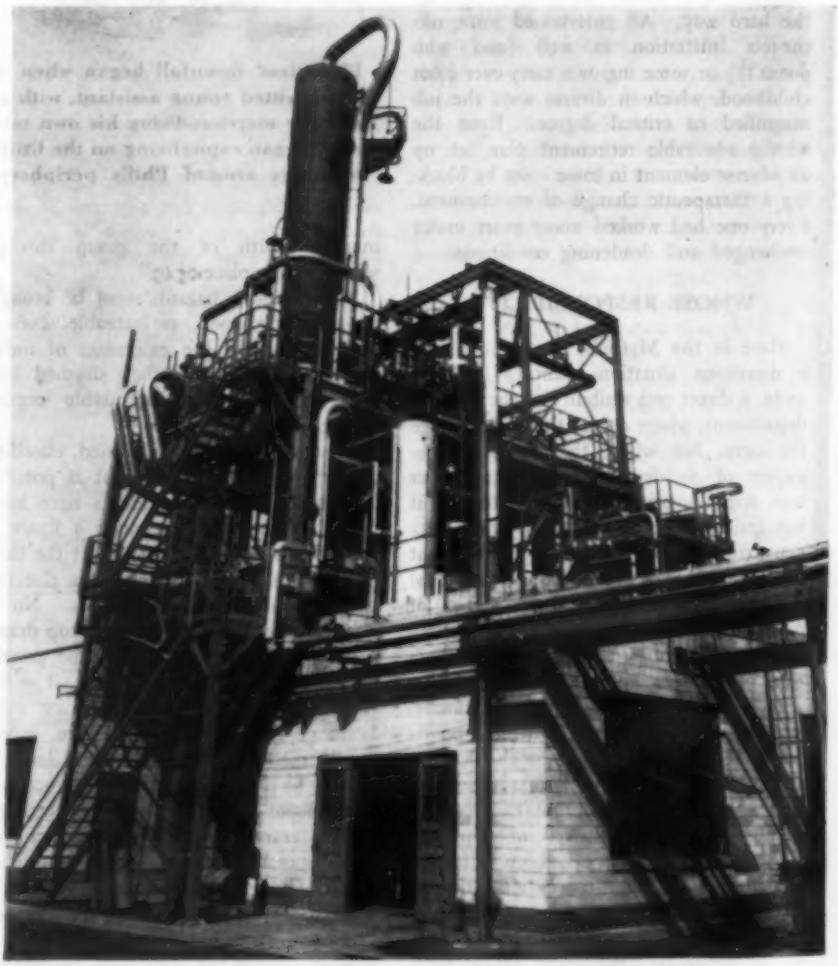
Following the profit motive, industry has never left its machine and process research to universities, foundations, or government, though gladly accepting their help. There is identically that same profit possibility in the biostatistics of men in the specific industrial plant environment. That puts the matter in plain business idiom, as free from philosophical abstractions as a fire. In other words, the safety department of the Mythical Chemical Co. in common with that of John Doe & Sons, Inc., and others ad infinitum do have a frontier.

JAMES A. LEE *Managing Editor, Chemical & Metallurgical Engineering*

FLUID CATALYSTS

Make Their Debut in Chemical Production

One of the most significant developments of recent years in the chemical industry is the application of fluid catalyst to the production of phthalic anhydride. Since its successful introduction into petroleum refining many organizations have been investigating means for adopting the technique to chemical processing. Sherwin-Williams is the first to achieve success. It is reasonable to believe that this pioneering venture is but the first of very many processes in which it will be used.—*Editors*



The process plant for making phthalic anhydride by use of fluid catalyst is dominated by the reactor, a steel vessel 5 ft. in diameter and 30 ft. high

OXIDATION of naphthalene to phthalic anhydride with the aid of a fluid catalyst represents the first commercially successful application of this technique to a process in the chemical industry. Fluid catalysts were first used in the petroleum refining industry and have been an important factor in the high-octane aviation gasoline program for two or three years. About two years ago Sherwin-Williams Co. conceived the idea of applying this technique to the production of phthalic anhydride and after conducting preliminary research employed the M. W. Kellogg Co., who had designed many of the refinery units employing the fluid catalyst, to cooperate with its engineers in the development of the process and to design and construct the plant. Although this commercial unit had been operating only a month when it was visited the results have been highly satisfactory.

Perhaps the principal advantage of the process is in the high purity of product which averages 99 percent phthalic anhydride. This purity is due to uniform contact between catalyst and reactants in the fluidized catalyst process resulting in ideal heat exchange conditions and allowing operation at a lower temperature than in fixed bed operation. This material without any purification is suitable for the production of certain esters and a very large percentage of the phthalic resins. The process can be operated with a ratio as low as 10 parts of air to 1 part of naphthalene with safety. The fluid catalyst offers a safer process from the standpoint of explosions, since the presence of this type of catalyst in the organic vapors breaks up any possible explosion wave. Less labor is required per unit of product. No buildings are required except for control room, catalyst plant, and air compressors. All other equipment is located in the open as in the case of petroleum refineries. Since

the process uses a contact time of several seconds, the naphthalene is injected into the reactor as a liquid and is vaporized therein, resulting in increased efficiency. These and other advantages stamp this development an outstanding success.

The process consists of passing heated air and naphthalene vapors at proper temperature up through a reaction vessel containing powdered catalyst. The oxidized naphthalene in the form of phthalic anhydride vapors are condensed after leaving the reactor and flaked for use in the company's synthetic resin plant.

Naphthalene (melting point 169-172 deg. F.) is received at the plant in tank cars, melted by passing steam through the coils in the car, and pumped into insulated storage tanks equipped with steam coils. As required it is pumped through a steam heated pipe line to the feed tank in the processing building from which it is fed to the lower part of the reaction chamber at the rate of 400 lb. per hr. In general, submerged centrifugal pumps are used for handling naphthalene and submerged proportioning pumps are employed for feeding it to the reactor.

The air supply for the reactor is delivered by reciprocating type compressors. Compressed air after passing through an air receiver goes to the air preheater where it is brought to the desired temperature. The heated air then passes to the bottom of the recycle catalyst cooler and upward to the reactor proper.

CATALYST

The catalyst is a very fine powder. The particle size is important. It is necessary that there be the proper balancing of coarse, medium and fine particles in order to obtain optimum fluidizing conditions.

The process centers around the reactor, a steel vessel about 5 ft. in diameter by 30 ft. high. When starting the unit the catalyst, which is stored in a conventional type of cone-bottom bin, is transferred into the reactor using the air lift principle. The reactor is brought up to operating temperature by air previously heated to 900 deg. F. in a gas-fired helical coil furnace. When the operating temperature is reached the flows of naphthalene and air into the reactor are started.

The naphthalene enters the reactor in molten state and is vaporized by direct contact with the catalyst charge. The vapors become admixed immediately with the air-catalyst mixture in the reactor due to the severely agitated nature of the catalyst bed. The air-naphthalene vapor mixture passes upward through the catalyst bed and the naphthalene is converted to phthalic anhydride, considerable quantities of carbon dioxide, carbon monoxide, and water vapor. It is interesting to note that a substantial proportion of carbon monoxide is formed in this operation whereas in the reactors of the fixed bed type very little if any carbon monoxide is obtained.

Reaction product gases after leaving the dense catalyst phase pass through a settling zone and into an internal cyclone system where a substantial proportion of the catalyst is removed from the vapors. The vapors and some catalyst dust leaving the reactor then pass through a cooler which reduces the temperature to a level somewhat above the due point of the phthalic anhydride. From this heat exchanger the vapors pass through a catalyst recovery system where complete removal of catalyst from the product gases is effected.

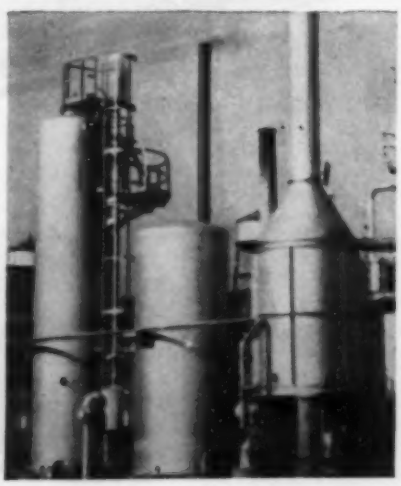
The catalyst recovery system consists of a series of three specially designed filters. Two of the filter drums operate in parallel on filtering while one is blowing back. Periodically one of the filters on the filtering portion of the cycle exchanges places with the one on blow back. And the equipment operates on a regular cycle controlled by time cycle controller.

During the blow back period the catalyst collected on the filtering medium during normal operation is blown off by reverse flow of air and the resulting air-catalyst mixture is returned to the reactor system. Since there is 100 percent recovery and no poisoning occurs as in the case of petroleum refinery cracking units it is not necessary to replenish the catalyst at any time.

The filtered product gases are passed to a phthalic anhydride recovery system which separates phthalic anhydride from the tail gases. The cooled tail gases are then passed to a scrubber system where washing is effected, and finally passed to the air.

Molten phthalic anhydride is transferred by gravity from the recovery system to a receiver. It was necessary to completely steam jacket all equipment in which phthalic anhydride comes in contact to prevent solidification. From the receiving tank the product is transferred by a submerged centrifugal pump to a feed tank from which it flows to the Stokes flaker.

Naphthalene is melted in heater on the right, storage tanks at left



The flaked phthalic anhydride is bagged to gave a final product.

Operating conditions in the reactor are less severe than in other currently used methods—temperatures are lower by several hundred degrees.

In the oxidation of naphthalene to phthalic anhydride about 10,000 B.t.u. is liberated per 1 lb. of naphthalene charged. Hence it can be seen that with a unit of large size the dissipation of sizable quantities of heat is a problem of much importance. One of the principal advantages of the fluidized system is its adaptability to easy dissipation of heat. The heat of reaction is converted to steam. The unit produces more steam than is consumed; hence the excess steam is condensed in a small surface condenser and is returned along with the condensate from other points of the system to the condensate accumulator from which the boiler feed water is drawn. In order to simplify the utilities system feed water for the unit is obtained by condensing all the steam produced. Obviously this practice would not be followed in a large plant.

CAPACITY

The unit was designed for charging 400 lb. per hr. of naphthalene and is capable of making 2,500,000 to 3,000,000 lb. of phthalic anhydride per year. It is now producing 75 lb. of phthalic anhydride per 100 lb. of naphthalene charged, and this rate of efficiency will be improved further no doubt.

The plant had been operating 35 days at the time it was visited, and had been operated at various feed rates up to the designed capacity. It is entirely possible that with more experience and when more details have been worked out that a greater capacity may be realized.

Control is all centralized in one main room. The control room houses the instruments for naphthalene feed rate, air flow rate, and temperature control, as well as certain other minor items of equipment such as phthalic anhydride condensers, important pressure gages, etc. Process control is obtained mainly by analyses of tail gases and spot samples of the product.

Inasmuch as there is only one reaction system for the particular unit regardless of size of the plant it is evident that the operating costs for a plant employing the fluidized technique is less than the smaller fixed bed type converters. This unit is handled by two operators for each eight-hour shift, with an extra man on the day shift who handles the auxiliary operations.

The pump room on one side of the main structure houses the air compressors, some of the pumps, and power distribution system of the unit. The remaining equipment with exception of the flaker is out of doors. The plant has the general appearance of a petroleum refinery unit.

S. D. KIRKPATRICK *Editor, Chemical & Metallurgical Engineering*

GERMAN PROPAGANDA

Post-Surrender Edition

Should Germany be permitted to operate her giant chemical industries to produce goods for reparations or export? Where is the line to be drawn between essential needs for the German civilian economy and her potentialities for war making? Already the Germans are trying hard to sell our military authorities on our needs for their goods. Therein may lie a dangerous threat to our own chemical industries as well as to world security.—*Editors*

ON MONDAY, *May 7, 1945—V-E Day–1* —a unique chemical exposition was held in the $450 million plant of the I. G. Farbenindustrie at Ludwigshafen on the Rhine. Elaborate exhibits had been set up to show the various peacetime products which the company was willing and anxious to make once it received the "go ahead" from the Allied Military authorities. The attractive showcases and samples were neatly labelled in English and there were several able English-speaking chemists on hand to answer questions.

The "customers to be sold" in this case were the purchasing and contracting officers of the U. S. Army. Theirs is the responsibility for supplying the needs of our military forces and if they can obtain these requirements over there for items that are still scarce in the United States, there would seem to be natural advantages in such transactions. On the other hand, there are immediate and long-time dangers that may not be quite so apparent.

Just by chance this writer happened to be an interested observer not only of the Ludwigshafen exhibit on May 7 but also of a similar but smaller one held the week before at the I. G. plastics plant at Troisdorf. On both occasions the Germans had been smart in selecting products of human and personal interest as well as of technical importance. At Dynamit A.G., for example, Dr. Minnis had an impressive array of ersatz leather made up in officers belts, holsters for pistols, riding boots, etc. There were attractive resin-coated military capes as well as beautiful raincoats such as our wives have long been waiting for. The young lieutenant who was my guide and guard was sure that the chemical industry of no other country could possibly produce so many wonderful products!

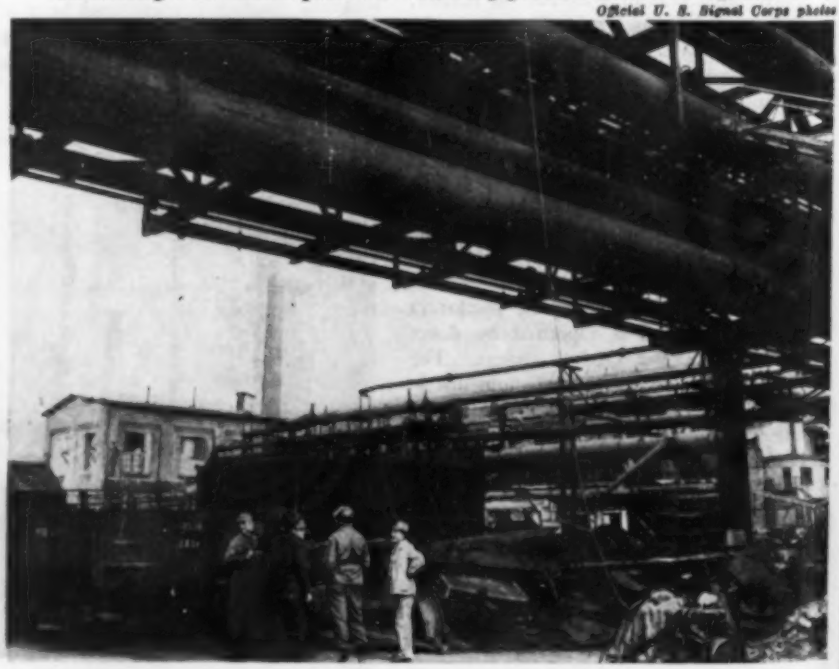
At Ludwigshafen the exhibits covered a wider range. Building materials included the light-weight insulation known as "Iporka" which presumably is urea-formaldehyde resin in sponge form. Polystyrene was shown as wire insulation as well as substitutes for cane and rattan, and in combs, brushes, bottles, etc. Dyestuffs of brilliant hues applied to fabrics, leather and paper, effectively demonstrated some of the plant's principal products—at the same time reminding the visitors that another I. G. subsidiary might have something to offer in new color photography.

These exhibits in themselves are of little significance. They can be duplicated in scores of plants and cities in the United States. But they do show the extent to which the German managements of these companies will go in trying to sell our military authorities on their hopes of getting these plants back into production without too much loss in time or in danger to their stockholders' investments.

Despite the fact that a large proportion of the buildings at Ludwigshafen had been destroyed through Allied bombings, at least 75 percent of the equipment was in operable condition according to our own observations. As shown by one of the official photographs taken at this plant on

Members of U. S. Army Continental Advance Section's 2853rd Engineer Gas Generating unit discuss plans for resuming production at Ludwigshafen

Official U. S. Signal Corps photo



Since this article was written, our Military Government on July 5 officially seized I. G. headquarters and 24 of its principal plants in the American zone of occupation. Control vested in Generals Eisenhower and Clay has been redelegated to Col. Edwin S. Pillsbury, former California lawyer and contract termination officer at Wright Field in Dayton. —S.D.K.

Major H. J. Euler, New Rochelle, N. Y., and Dr. B. J. C. Timm, German physicist, studying I.G. exhibit to determine what products may be developed for U. S. uses

U. S. purchasing and contract officer examining a sample of buna-treated fabric. With him is Dr. Karl Wurster, German director of the works at Ludwigshafen

May 7, a gas-generating unit had been in operation since April 21, producing oxygen for U. S. Army uses. During my visit to the buna laboratories and pilot plant at Leverkusen, Dr. Conrad received permission from the American Military Government to use some of the 40 tons of synthetic rubber then on hand for the manufacture of tires for American jeeps. (See *Chem. & Met.*, June 1945, pp. 94 to 96.) So it is evident that some production is already under way. How far can and should it be expanded?

Indicative of what might be produced at Ludwigshafen are some of the following figures supplied on April 7, 1945 by the German management to Lieut. John Marshall, C.W.S., who was then liaison officer between the I. G. and the American Military Government at Ludwigshafen:

Aniline—This plant can produce 300 metric tons per month by the continuous catalytic reduction of nitrobenzol. (This is equivalent to about 19 percent of U. S. production in 1939.) Plant and equipment 95 percent preserved.

Butanol—From crotonaldehyde, can make 600 to 900 tons per month. Plant and buildings 85 percent preserved, equipment 95 percent preserved.

Methanol—Can make and purify with potassium permanganate 1,000 tons per month at Ludwigshafen and 550 tons per month at Oppau. Plant 85 percent preserved; equipment 90 percent preserved.

Formaldehyde—Can make 6,000 tons per month in plant 75 percent preserved; equipment 60 percent. (This is equivalent to four-fifths of the entire U. S. prewar production.)

Synthetic Fatty Alcohols—Can make 200 tons per month by catalytic hydrogenation of fatty acids and ketones. Plant 85 percent okay; equipment 95 percent.

Synthetic Fatty Acids—Can make 1,600 tons per month by catalytic oxidation of paraffins. Plant 60 percent preserved; equipment 80 percent.

Urea-Formaldehyde Resin—Can make 900 tons per month by condensing 50 percent urea at 100 deg. C with formaldehyde. Plant is 70 percent preserved; equipment 90 percent.

Aviation Fuels

(1) So-called "Rohisobutyl 131" is made by azeotropic distillation of crude isobutylene oil. Capacity 12,000 tons per month. Plant 90 percent okay; equipment 80 percent okay.

(2) Iso-octane is made from isobutylene which is polymerized to the di- and tri-isobutylene, then hydrogenated under pressure. Capacity 370 tons per month. Plant 80 percent preserved; equipment 75 percent preserved.

(3) Gasoline and lubricants made from crude oil by distillation, dewaxing with ethylene chloride followed by centrifuging. Capacity 2,600 tons per month. Plant 80 percent preserved; equipment 75 percent preserved.

Fertilizers

(1) Various Haber-Bosch units listed at capacities of 8,000 tons per month, 750 tons per month, 400 tons per month, and 120 tons per month. Plant is 80 percent preserved and equipment 60 percent.

(2) Ammonium sulphate made by the reaction of calcium sulphate, ammonia and carbon dioxide. Capacity 2,500 tons per month. Plant 40 percent preserved; equipment 80 percent preserved.

Major P. J. Winkler, of Continental Advance Section, examining a block of lightweight insulating material

U. S. soldier studies a display of color photographs showing application of German dyestuffs to fabrics

I. G. Farbenindustrie's $450 million plant at Ludwigshafen is now producing liquid oxygen for use by U. S. Military Forces. Staff Sergeant Max Taylor of Elmira Heights, N. Y., looks on as German foreman chalks up production figures for run that began April 21, 1945

(3) Nitrophoska—Can make 9,000 tons per month by adding phosphoric and nitric acids to crude phosphate and neutralizing with ammonia before adding potassium chloride to make a product containing 12 percent N_2, 12 percent P_2O_5, and 21.5 percent K_2O. Plant and equipment 80 percent preserved.

(4) Kalk-Ammon-Saltpeter — made by mixing 60 parts of ammonium nitrate with 40 parts of lime to yield a finished product containing 20.5 percent N_2. Plant 90 percent preserved, equipment 95.

(5) Ammonium Nitrate—1,500 tons per month. Plant 90 percent okay; equipment 90 percent okay.

(6) Urea—made by mixing one part CO_2 with two parts NH_3 at pressure of 120 atmospheres at temperature of 150 deg. C. This plant has a capacity of 2,100 tons per month. Plant 80 percent okay; equipment 90 percent okay.

(7) Chlor-Ammon—capacity 1,500 tons per month of ammonium chloride. Plant 95 percent okay; equipment 85.

(8) Nitric Acid—6,000 tons of nitrogen in the form of 9 percent NH_3 can be oxidized per month over platinum catalysts. Plant 60 to 65 percent okay; equipment 60 percent.

Polystyrene—Made at Ludwigshafen by mass polymerization of styrene at elevated temperatures. Capacity 400 tons per month. Plant only 20 percent preserved; equipment 25 percent.

Miscellaneous Products	*Capacity in Tons per Month*
Boron Fluoride	3
Iron Carbonyl	80
Nickel Powder	350
Acetylene	3,000
Polyvinyl Chloride	170
Adipic Acid Dinitrile	40
Hexamethylene Diamine	60
Phthalic Acid	150
Formamide	900
Isobutyl Alcohol	200
Acrylic Ester	300

Dyestuffs	*Capacity in Tons per Month*
Basic Dyes	148
Acid Dyes	143
Vat Dyes	304
Rayon Dyes	30
Pigment Dyes	50
Special Dyes	170
Total	845

From the foregoing estimates made by the German management of the Ludwigshafen-Oppau plants, it is evident that a sizable production of many important chemicals could readily be obtained as soon as raw materials are available and operations officially authorized by the Control Council. Many of these products are as important in war as in peace. Many can be produced on a scale far in excess of our military needs in Europe or of the requirements for an essential German economy. To permit such plants to operate on so large a scale would constitute a threat to world security.

Despite destruction by Allied bombings, German management claims that production can quickly be resumed in this calcium carbide plant

V. P. VICTOR *Consulting Engineer, New York, N. Y.*

Air Recirculation in Drying of UNBOUND MOISTURE

In this study of drying by convection for removing unbound moisture from materials, the author points out that dryer performance is often limited by inadequacy of the air supply. He offers new graphical presentations of drying potential of air of various conditions and shows how economical conditions can be selected. After demonstrating the usefulness and theoretical basis for a number of "rules of thumb" used in drying calculations, he presents equations for design and for checking dryer performance.—*Editors*

Drying, the process of removing moisture from solid materials by evaporation, requires that the material receive sufficient heat to effect the transformation of the liquid into vapor form. Depending on conditions, or on the nature of the material, the evaporation can take place either inside or on the surface of the slab, while the heat may be transferred to the material either by conduction, radiation or convection, or generated electronically within the material itself. Ruling out other means, this paper deals only with convection drying at atmospheric pressure, where air is both the heat carrying and the moisture removing medium. Nevertheless, the principles outlined apply also to the other methods of heating.

Although drying characteristics of materials often establish certain limitations, dryer design usually permits wide latitude in the numerous possible combinations of temperature, humidity and air flow rate. For the sake of simplicity, the drying of a given material can be considered as divided into two stages, an earlier stage when the rate of moisture removal is limited by the ability of the circulated air to pick up moisture, known as the constant drying rate stage; and a second stage when it is the willingness of the material to give up moisture that controls the drying rate, which is known as the falling rate stage. In the second stage the rate of air circulation is relatively unimportant, but its conditions of temperature and humidity assume utmost importance.

During the second stage the rate at which moisture moves to the point where evaporation is taking place depends upon specific properties of the material, since it moves by osmosis (through the cell walls) and by diffusion (flow through the whole slab). What may be termed the mechanism of drying is the study of these properties of the material in relation to the conditions of the circulated air, the moisture content of the material and the time required to achieve the desired results. On the other hand, the creation of suitable external conditions for drying may be called the thermodynamics of drying. The two, obviously, are closely interrelated.

When a wet material is subjected to drying, it will eventually reach a moisture content which is in equilibrium with the drying air. This moisture content, known as the regain point, depends both on the nature of the material and on the temperature and humidity of the air. Moisture which is in excess of the equilibrium content is called free moisture. However, not all of the free moisture in most materials is what is known as unbound. Unbound moisture is that moisture which exerts its full vapor pressure at the existing temperature. When a certain moisture content is reached, the remaining, or bound, moisture will exert a vapor pressure which is less than that corresponding to the temperature for any of several reasons. It may, for example, be in solution with the material, or it may be adsorbed in the cracks and crevices, or held in the cells of the material. We are here concerned only with the removal of unbound moisture. In many, if not the majority of materials from which unbound moisture only is to be removed, the speed of drying in numerous installations is limited unnecessarily by inadequate treating or contact means. Our problem is how this may be avoided.

Air, preheated by apparatus which is usually located outside the drying chamber, is brought in contact with the material. Heat is transferred from the air to the material, and after the latter comes up to drying temperature, further supply of heat will cause a corresponding quantity of liquid to become vapor. Under these conditions each unit of heat which air gives up is compensated for by an equal quantity of heat contained in the liberated vapor. In other words, the sensible heat of the air is converted into latent heat, but the total heat content of air passing over the material remains constant. Hence, the name "adiabatic" has been assigned to this most commonly used type of dryer. Needless to say, the wet bulb temperature also remains constant and the entire cycle is comparable with evaporative cooling with one major difference: in drying the air seldom reaches saturation.

CONVECTION DRYING

The rate of air flow is usually expressed in terms of cubic feet per minute at prevailing conditions, or at 70 deg. F. and 1 atm. Dry air under the latter conditions has a density of 0.075 lb. per cubic foot; i.e., there are 13.35 cu.ft. in 1 lb. of dry air. Neither method of expression is satisfactory because in the first case the volume is relative, varying considerably with temperature and/or humidity. It is, therefore, misleading. "Standard" dry air of 13.35 cu.ft. per pound does give an absolute unit, but in reality this density covers the range from 61 to 70 deg. F. dry bulb temperature at 100 and 0 percent R.H. respectively, and it does not show the added volume required for the water vapor.

In the final analysis we do deal with actual volumes of circulated gases, be they air, water vapor, or products of combustion. Face area velocities of heat exchangers, duct and outlet velocities, as well as fan capacities, all have to be determined by actual volumes rather than some convenient unit in theoretical computations.

The commonly used unit of moisture content, namely, "grains per cubic foot of air," is again misleading. Heating air at constant pressure will increase its volume

and reduce the grains of moisture per cubic foot. The solution is to employ the absolute unit of grains per pound of dry air which is independent of variations in the dry bulb temperature.

Obviously, computations based on the dry air content of the total circulated volume may cause an erroneous selection of the fan and drastically reduce the air circulation through the dryer. This is especially pronounced at higher humidity and temperature levels. For example, with air at 300 deg. F. dry bulb temperature and 135 deg. dew point temperature, the actual volume of 1 lb. of dry air and accompanying moisture will be 23.1 cu.ft., whereas the volume of the dry air alone at 300 deg. F. will be 19.2 cu.ft.

The specific volume of air at specified conditions can be found from the following equation:

$$V_s = V_{s_s} \times (t_{d_s} + 460)/(t_{d_s} + 460)$$

where V_s = specific volume at the given conditions, cu.ft. per lb. of dry air; V_{s_s} = volume of 1 lb. of dry air plus the vapor to saturate it at the given dew point temperature, cu.ft.; t_{d_s} = the given dry bulb temperature, deg. F.; and t_{d_s} = the given dew point temperature, deg. F.

All of the computations in this article will be carried out with 1 lb. of air as the basic unit, conversion to actual volume being made after the temperature and humidity have been established.

HOW MOISTURE IS EJECTED

In order to maintain predetermined drying conditions, the addition of vapor to the air circulated through the dryer must be properly compensated for. The liberated moisture is usually removed from the drying chamber by one of several methods which can be divided into four major groups, as follows:

1. The entire volume of circulated air is preheated, passed through the dryer, and ejected to the outside. In other words, there is no air recirculation. There may be numerous reasons for this practice. For example, the expense of cleaning the contaminated air leaving the dryer may exceed the cost of preheating or of otherwise treating the make-up air.

2. The entire volume of circulated air is constantly recirculated and reheated. There are no visible provisions for exhaust, and it may be said that the rate of air recirculation is 100 percent. The moisture content of the circulated air is gradually built up and apparently should reach a point beyond which no further drying, even of the unbound moisture, would be possible. However, this is not the case for several reasons.

When the dry bulb temperature maintained in the dryer (or in the exhaust) is *below* 212 deg. F., theoretically it should be possible to achieve saturation. In practice, however, the equipment and drying chamber are seldom air and vapor tight. There may be openings for the entrance and exit of the material, as well as access doors, and there will be small leaks at the fan inlet, air heaters, filters, etc. Therefore, unless the entire system is designed and built as a closed pressure vessel, like a boiler or vacuum tank, it is physically impossible to attain an air recirculation of 100 percent. From 5 to 10 percent of the circulated air will always leak out and with it the corresponding amount of moisture. This natural spill or exhaust may sometimes be as high as 20 percent.

When the dry bulb temperature maintained in the dryer (or in the exhaust) is *above* 212 deg. F., both theoretically and practically it is impossible to achieve saturation, as long as the entire system operates at atmospheric pressure. The reason for this often misunderstood fact is that "saturated air" at 212 deg. F. and at the atmospheric pressure is no longer air; it is pure steam without any air content. Hence, the presence of any air will result in an air-vapor mixture with a dew point temperature below 212 deg. F. Conversely, the achievement of "dew point" temperatures above 212 deg. F. necessitates the creation of pressures above atmospheric. Because of these unalterable properties of steam, air does not possess relative humidity at and above 212 deg. F. dry bulb temperature and wet bulb (adiabatic saturation) temperatures equal to or above 212 deg. F.

Another practical meaning of this physical fact is that with an adiabatic convection type dryer using externally preheated air, it is impossible to heat the unbound moisture contained in the material to and above 212 deg. F., regardless of the initial dry bulb temperature of the supply air. In other words the unbound moisture will never "boil." (However, this is not true in either conduction, radiation, or electronic drying.)

Thus, unless the entire drying system is a hermetically sealed vessel with air evacuating means or vacuum pumps, the maximum attainable humidity level in a commercial convection type dryer is limited to approximately 180 to 190 deg. F. dew point temperature. Ample insulation of all surfaces coming in contact with such high humidity air must be provided in order to avoid condensation.

Statements previously made on the matter of natural spill also hold true in this instance. Thus, in the case of dryers having no visible means of moisture ejection or removal, and operating on the principle of maximum air recirculation, the vapor is self-eliminating via natural exhaust or spill.

3. The drying system operates at a humidity level equal to or below that prevailing outside. Provisions are incorporated in the system for the removal of liberated moisture by such methods as condensation (cooling below the dew point temperature and subsequently reheating), physical adsorption (as with activated alumina or silica gel), or by chemical absorption (as with lithium chloride solution or other hygroscopic materials). Drying of unbound moisture seldom requires air dehumidification, and is used only when the material must be dried at low temperature.

4. The commonest and most widely used method of maintaining a predetermined humidity level in a dryer is the intentional spilling or exhausting of a certain portion of the circulated air, which is made up by the admission of outside air. It will be shown later that the operating humidity level will always be above that prevailing outside the dryer.

AIR RECIRCULATION

Besides offering a simple means of ejecting excess vapor from the circuit, partial air recirculation also improves the efficiency from the standpoint of heat distribution, utilization, and control (because of the reduction in the "process lag"). One of the questions confronting both the designer and the user of a dryer is how much air should be exhausted and what is the most economical point.

Because of the evaporative adiabatic cooling of the supply air, the theoretical ability of air to pick up moisture corresponds to the difference between the final saturation content at the wet bulb temperature and the initial moisture content at the supply air dew point temperature.

In practice, maximum efficiency is not attained. The degree of approach is called "percent theoretical pick-up" and is the ratio of the actual pick-up to the theoretical (maximum) pick-up. Air distribution, rate of air circulation, nature of the material and the material handling means, all influence the actual pick-up to a greater or lesser extent, and their combination applies only to a specific case. To be general, only the theoretical pick-up needs to be considered at this point.

In Fig. 1, the theoretical pick-up* has been plotted for various dry bulb and dew point temperatures of the supply air. The graph was based on the supply air instead of the return air (considered as representative of the maintained conditions in the dryer) because the actual pick-up and the percent of the theoretical pick-up (and hence the condition of the return air) are functions of the dryer design and of the material properties, and therefore cannot be generalized.

Assuming the maximum practical dew point temperature to be limited to 180 deg. F., this family of curves forms a minimum "neck" at 260 deg. F. dry bulb temperature. The theoretical pick-up remains practically constant (from 220 to 250 grains per pound) regardless of the dew point temperature. In practical lan-

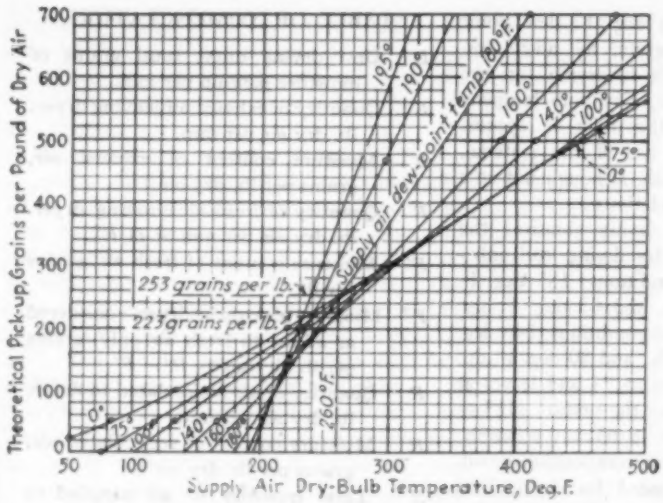


Fig. 1—Adiabatic drying chart showing theoretical pick-up for air of various dry-bulbs and constant dew points

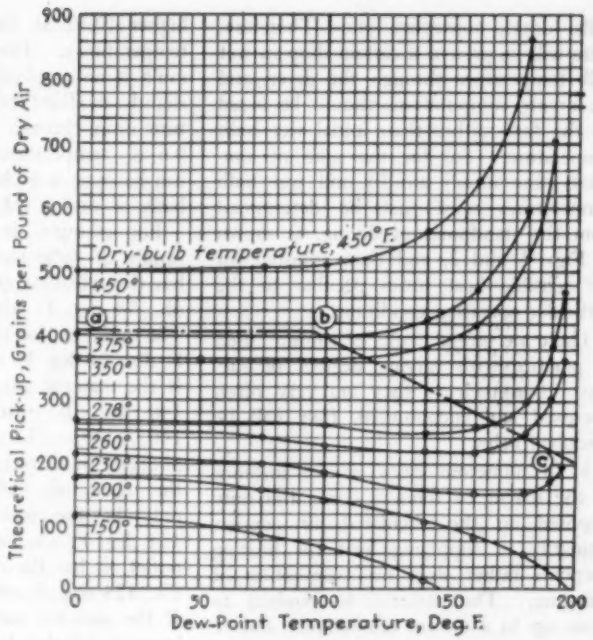


Fig. 2, Right—Chart showing effect of humidity (dew point) on drying at various constant dry bulb temperatures

guage this means that in this region of supply air dry bulb temperatures, the rate of air recirculation will not affect the drying either way. Variations caused by seasonal changes or by vagaries of weather are practically nullified, and there is nothing to gain through the use of dehumified air. At this point, the theoretical pick-up is substantially the same for 0 deg. F. and 180 deg. F. dew point temperatures.

At a glance this chart also makes it possible for one to establish "equi-drying" conditions of supply air. For example: air of 130 deg. F. dry bulb and 75 deg. F. dew point possesses the same theoretical pick-up as air of 190 deg. F. dry bulb and 160 deg. F. dew point. This comparison becomes more pronounced at higher temperatures. For instance: equi-drying conditions are represented by air of 510 deg. F. dry bulb and 100 deg. F. dew point and by air of 375 deg. F. dry bulb and 180 deg. F. dew point.

It is quite true that during the initial drying stages, the material will assume the prevailing wet bulb temperature, but in the final stage it will tend to approach the dry bulb temperature. For this reason, Fig. 2 has been prepared to show the relation between the theoretical pick-up, dew point temperatures, and constant dry bulb temperatures of the supply air. The chart is also applicable to isothermal (constant temperature, radiation type) drying. This family of curves accentuates the effects of recirculation.

It is to be observed that greater air recirculation at lower dry bulb temperatures will reduce the pick-up. As the temperature is increased the reduction in the pick-up is progressively smaller and in the region of 260 to 278 deg. F. it becomes negligible. On the contrary, the pick-up after a slight initial reduction is rapidly increased after a certain dew point temperature is reached. With 260 deg. F. dry bulb temperature, the pick-up is restored to its initial magnitude at 180 deg. F. dew point temperature. Thus, the broken line abc divides the drying conditions into two sections. Above this line the pick-up is increased with greater recirculation.

In practice, however, the heat economy has to be considered, as well as the theoretical pick-up. Summarizing the data of Figs. 1 and 2, the dividing line can be set at 260 deg. F. dry bulb temperature. Above this temperature an increase in recirculation will result in heat economy and possibly greater pick-up, but under no conditions will the drying speed be impeded to an appreciable extent. Below the 260 deg. line the sacrifice in heat economy must be balanced against a gain in drying speed, or vice versa. The rate of air recirculation must be carefully determined in each case, especially in the region above 75 deg. F. dew point temperature.

Further study of these curves will reveal that in the drying of unbound moisture there is very little to be gained by air dehumidification. The questions of equilibrium moisture content and of the regain of hygroscopic materials pertain to the removal of the bound moisture, and are not included in the scope of this paper.

It must be understood that throughout this entire discussion, emphasis is placed on operation at various humidity levels or concentrations as derived from the air recirculation. In other words, humidity is built up by means of moisture liberated by the material, rather than by supplementary air humidifying means which consumes extra heat or power. In the latter case, the problems of heat economy and of air recirculation should be analyzed separately.

PRACTICAL CONSIDERATIONS

During the first stage of drying, and to a lesser extent thereafter, the circulated air is required to furnish a quantity of heat in addition to that needed for drying, to heat up the material and to offset sensible heat losses through the housing

* No psychrometric charts based on the present A.S.H.V.E. tables are available for high temperatures above 170 deg. F. At the same time the old tables on which the Carrier high temperature charts were based cover the range five degrees apart, and therefore do not possess sufficient accuracy. The determination of the theoretical pick-up for Fig. 1 was conducted as follows:

1. For the given dew point temperature look up in the A.S.H.V.E. tables the grains per pound, weight of saturated vapor per pound, and the total heat content per pound of dry air.
2. In another A.S.H.V.E. table look up the specific heat per pound of air-vapor mixture at the same dew point temperature.
3. Add the desired theoretical pick-up to the grains per pound as established in (1) and then from the tables determine the corresponding wet bulb temperature with its total heat content per pound of dry air.
4. Compute the degrees of superheat of the air-vapor mixture at the given dew point temperature and the wet bulb temperature determined in (3) by first subtracting the heat content of (1) from the heat content of (3), and then dividing this difference by the product of the specific heat of (2) and the weight of the mixture consisting of 1 lb. of dry air, plus the weight of saturated vapor of (1).
5. Determine the dry bulb temperature of the mixture at the given dew point temperature and the wet bulb temperature of (3), by adding the degrees of superheat of (4) to the given dew point temperature.

An example is as follows:

1. Given the dew point temperature of 140 deg. F. From tables the weight of saturated vapor is 1,664.7 grains or 0.152 lb. per lb. of dry air. The heat content of the dry air with the vapor to saturate it is 204.3 B.t.u.
2. The specific heat of the saturated air at 140 deg. F. is 0.268 B.t.u. per lb. of mixture.
3. The desired theoretical pick-up is 500 grains per lb. The moisture content at adiabatic saturation with this pick-up is 1,065 + 500 or 1,565 grains. From the tables the corresponding wet bulb temperature is, by interpolation, 151.8 deg. F. and the heat content is 288.5 B.t.u.
4. The degrees of superheat equals 288.5 — 204.3, or 84.2, divided by 0.268 × (1.0 + 0.152) which equals 272.4 deg. F.
5. The dry bulb temperature is 272 + 140, or 412 deg. F.

Data for Fig. 2 were computed in a similar way. In both Fig. 1 and Fig. 2 the wet bulb temperatures were not plotted.

walls, ducts, conveyors, etc. Therefore, there will be present a certain drop in wet bulb temperature through the dryer, and the drying computations should be based on the final rather than initial wet bulb temperature. So, for the sake of simplicity, the supply air dry and wet bulb temperatures must first be determined from the standpoint of drying, as shown in Figs. 1 and 2, and then adjusted for the sensible heat losses peculiar to the particular operating conditions.

There are several "rules of thumb" used in practice with varying degrees of success. Inasmuch as they are very often discussed and encountered, they will be described below.

1. In numerous cases, as for instance in the baking of foundry cores, the duty imposed on the circulated air consists primarily in supplying heat for heating purposes rather than for evaporation of moisture. The material is required to come up to a certain temperature and to stay at this temperature for a given period of time. The work done by the air is then measured in terms of the dry bulb temperature drop between the inlet and outlet of the oven. Incidentally, the name "oven" is vaguely assigned to installations operating either at temperatures in excess of 250 deg. F., or where the sensible heat load represents a substantial portion of the total duty.

The cardinal difference between a convection type oven and a dryer, regardless of the involved temperatures, is that in an oven the heat content of the outlet air is considerably below that of the supply air because of the loss of sensible heat, whereas in a dryer the heat contents of the inlet and outlet air are practically the same owing to the conversion of sensible heat into latent heat.

Absence of standardized nomenclature is responsible for the existence of greatly misleading mongrel terms such, for example, as "drying oven".

In oven design, the common practice is to determine the rate of air circulation on the basis of making the temperature drop equal to approximately one-third the rise in the material temperature. So far, no logical explanation has been advanced for this rule, but in practice it works. The rate of recirculation is limited by the necessity of ejecting objectionable fumes, rather than because of the accumulation of moisture. Practically all oven computations are based on a simple equation dealing with sensible heat only. This equation is: B.t.u. per hr.=cu. ft. per min. × 1.1 × the temperature drop, which is derived from the expression: B.t.u. per hour. = cu. ft. per min. × (0.242 x 60/13.35) × the temperature drop.

The specific heat of air-water vapor mixtures does not remain constant at 0.242 and may be as much as 34 percent higher (0.32 at 180 deg. F. dew point temperature). Therefore, the above formula is not applicable to drying, but the slightly modified rule: Dry bulb temperature drop through the dryer = approx. 0.6 × temperature rise of the material, can be used as a check, although not as a basis of drying calculations.

For example, in drying abrasives the supply air (adjusted for drying load only) has the following conditions: 185 deg. F. db., 94 deg. F. wb., and 67 deg. F. dp. The outlet air has the conditions; 146 deg. F. db., 94 deg. F. wb., and 80 deg. F. dp. If the material enters at 75 and leaves at 140 deg. F., then the ratio $(185 - 146)/(140 - 75) = 39/65 = 0.6$ exactly. Similarly in a dryer for composition board, the supply air (adjusted for drying load only) has the conditions: 400 deg. F. db., 124 deg. F. wb., and 84 deg. F. dp. The outlet air has the conditions: 295 deg. F. db., 124 deg. F. wb., and 104 deg. F. dp. If the material enters at 75 deg. F. and leaves at 270 deg. F., then the ratio $(400 - 295)/(270 - 75) = 105/195 = 0.54$, or close to 0.6.

2. Prevailing practice in the drying of unbound moisture is to set the air recirculation rate at from 40 to 50 percent of the total air circulation. Obviously, with any fixed air recirculation, the drying conditions will change constantly because of variations in the humidity of the make-up air. The theoretical pick-up may not be appreciably affected, as shown by Figs. 1 and 2, but the heat consumption will suffer unquestionably.

Without retarding the drying speed, greater quantities of air can be recirculated in winter time or during periods of lower outside air humidity, than during humid weather. It is not unusual, but very often rather surprising, to find out that less heat is required for drying in winter than in summer, provided the drying conditions in both cases are alike.

DRYER ANALYSIS

The actual percentage of air to be recirculated is a function of the total air circulation. The establishment of intimate contact between air and material, the desirability of maintaining uniform conditions or of keeping the air temperature drop through the dryer as low as possible, the susceptibility of the material to spoilage from excessive temperature or prolonged drying time, are other cardinal points to be considered in determining the total air circulation. Precision of control may also require higher rates of air circulation in order to reduce the process lag, that is, the time it takes for air to complete the circuit relative to the position of the controlling instruments. Should the rate of air circulation be limited by permissible velocities, the first alternative is to increase the supply air temperature. If this is also undesirable, the second alternative is to use dehumidified air. One should not overlook also the possibility of preforming or of preheating the material prior to drying, as well as the utilization of moderate radiant heating in conjunction with convection drying.

It is not within the scope of this paper to discuss the subject of air circulation in drying, but only the effects of air recirculation and operation at high humidities, which is sometimes referred to as "superheated steam" drying.

In order to illustrate the relations between actual pick-up, humidity levels, and recirculation, the simplest drying cycle with humidity control is illustrated in Fig. 3. The equations which follow, in spite of their simplicity, are very often ignored. They make it possible for one to check quickly the performance of an operating drying system or to check the design data of a proposed installation, as well as to determine the rate of air recirculation without measurement of the air flow (see Equation 2), which sometimes is extremely difficult. A graphical interpretation of these equations appears in Fig. 4.

$$S'' = (F'' \times \%F)/100 = F''(1 - R/S) \quad (1)$$

$$\%R = 100(1 - S''/F'') \quad (2)$$

$$S_T'' = 100(R' - S')/\%P \quad (3)$$

$$S_T'' = (F'' \times \%F)/\%P \quad (4)$$

Equation (4) offers a means for ready

TABLE OF NOMENCLATURE

D	Unit drying duty, total grains of moisture pick-up per min.
E	Quantity of exhaust air leaving dryer, lb. dry air per min.
E'	Moisture content of exhaust air, grains per lb. dry air
F	Quantity of fresh air entering dryer, lb. dry air per min. = D/F''
F'	Moisture content of fresh air, grains per lb.
F''	Moisture pick-up in dryer, considered as added to fresh air only, grains per lb. dry air = $R' - F'$
R	Quantity of air recirculated to dryer, lb. dry air per min.
R'	Moisture content of recirculated air, grains per lb. dry air
S	Total quantity of air supplied to dryer, lb. dry air per min., = $R + F = D/S''$
S'	Moisture content of supply air, grains per lb. dry air
S''	Moisture pick-up in dryer by supply air, grains per lb. dry air = $R' - S'$
S_T''	Theoretical pick-up in dryer by supply air, grains per lb. dry air
T'	Moisture content of saturated air, grains per lb. dry air
$\%F$	Percent fresh air in supply = $100(1 - R/S)$
$\%P$	Percent moisture pick-up = $100(S''/S_T'')$
$\%R$	Percent recirculated air in supply = $100(R/S)$

analysis of drying conditions—first, qualitatively; and second, quantitatively. The procedure, of course, can be reversed, but in any event one must agree or check with the other.

In practice, the percent pick-up, which is specific to the selected type dryer and given material, is fairly well established. The design conditions, or the initial moisture content F' of the make-up air (which is determined by the weather or by dehumidification) is also known. This is shown in Fig. 4 by the line labelled "fresh air." The second step is to locate the maintained humidity level in dryer, which is determined by the rate of fresh air flow. This is shown in Fig. 4 by the recirculated air line R'. The difference, in grains of moisture per pound of dry air, will be the fresh air pick-up F'', and its magnitude will be inversely proportional to the rate of the fresh air flow. The actual or supply air pick-up will be equal to only a fraction of this difference as shown by Equation (1).

Having established the humidity level of the supply air line at moisture content S', essentially by selecting the percent of recirculation, the moisture content at adiabatic saturation will be represented by the intersection of the line for saturated moisture content T' with the saturation curve. The wet and dry bulb temperatures are then easily found.

DESIGN COMPUTATIONS

Assume a pick-up of 35 percent and a unit drying duty of 15,000 grains per min. Let the moisture content of the fresh make-up air be 118.2 grains per lb. of dry air (72 deg. F. dew point) and assume an air recirculation of 90 percent for high heat economy. Neglecting sensible heat losses, let the maximum supply air temperature be 150 deg. F. If the maintained humidity level R' in the dryer is 413.3 grains per lb. (110 deg. dew point), will the necessary supply of air temperature be satisfactory?

The fresh air pick-up will be $F'' = R' - F' = 413.3 - 118.2 = 295.1$ grains per lb. of fresh air, and the actual or supply air pick-up $S'' = 295.1 \times \%F = 295.1 \times (100 - 90)/100 = 29.5$ grains per lb of supply air. The theoretical pick-up S''_T will then be $29.5/0.35 = 84.3$ grains per lb. of supply air. The dew point temperature of the supply air is 108 deg. F., corresponding to a moisture content of $413.3 - 29.5 = 383.8$ grains per lb. of supply air. This being the case, the supply air wet bulb is 114 deg. F., which corresponds to a moisture content of $383.8 + 84.3 = 468.1$ grains per lb. This will require a supply air dry bulb of approximately 165 deg. F., which according to specifications is high.

It will be found that if a dew point temperature of 106 deg. F. is maintained (364 grains per lb.), rather than 110 deg., the requirements will be fulfilled. Here $F'' = 364 - 118.2 = 245.8$; $S'' = 0.1 \times 245.8 = 24.6$; $S''_T = 24.6/0.35 = 70$; the dew point of the supply air will be $(364 - 24.6 = 339.4)$ 104 deg. F.; the wet bulb of the supply air will be $(339.4 + 70 = 409.4)$ 110 deg. F.; and the dry bulb of the supply air will then be 150 deg. F. The rates of air flow will be $F = 15{,}000/245.8 = 61$ lb. per min. and $S = 15{,}000/24.58 = 610$ lb. per min. As a check $(118.1 \times 0.1) + (364 \times 0.9) = 11.82 + 327.6 = 339.4$ grains per lb. of supply air, which checks with the calculation above for the dew point temperature.

To check a case of actual dryer performance: The moisture content of the fresh air was 131 grains per lb., a dew point temperature of 75 deg. F. The supply air was measured at 425 deg. dry bulb and 167 deg. wet bulb, giving a dew point of 160 deg. F. and a moisture content S' of 2,073 grains per lb. The exhaust air was measured at 290 deg. dry bulb and 166 deg. wet bulb, a dew point of 163 deg. F., corresponding to a moisture content $E' = R'$ of 2,307 grains per lb. Then $F'' = 2{,}307 - 131 = 2{,}176$ grains per lb. of fresh aid and $S'' = 2{,}307 - 2{,}073 = 234$ grains per lb. of supply air. The percent recirculation, by Equation (2), is $100\ (1 - 234/2{,}176) = 89$ percent. The percent pick-up, by definition, is then $S''/S''_T = 234/(2{,}600 - 2{,}073) = 44$ percent.

Air at 160 deg. dew point and 166 deg. wet bulb temperature has a dry bulb temperature of 400 deg. F. This difference of 25 deg. represents the sensible heat loss.

In order to establish the drying load, the rate of either the total air circulation or of the primary air flow must be measured. Conversely if the reduction in weight of material is known, the rates of air flow can be easily computed from the above.

In summary, air recirculation in the drying of unbound moisture should be analyzed from two distinct angles, that of heat economy, and the ability of the air to pick up the moisture. Above 260 deg. F. supply air dry bulb temperature, the greater the recirculation is, the higher will be the drying speed and the heat economy. For equal drying speed the dry bulb temperature and the physical size of the drying system (hence, initial cost) can be reduced. For instance, with a 350 deg. F. dry bulb and a 100 deg. dew point, air has 370 grains pick-up, whereas with a 350 deg. dry bulb and a 180 deg. dew point, air has 525 grains pick-up, or 42 percent more. For the same pick-ups of 370 grains, but with a 180 deg. dew point, the dry bulb temperature can be reduced to 300 deg. F.

On the other hand, below a 260 deg. F. supply air dry bulb temperature, a compromise between heat economy and drying speed will have to be made.

Fig 3—In a recirculating dryer, neglecting air leakage, the air balance shows that $F + R = S$ and $F = E$, while $D = (E' - S') = (E' - F')$ F; F, R, S and E are quantities of air; D is unit drying duty; and primed letters are quantities of moisture per pound of dry air

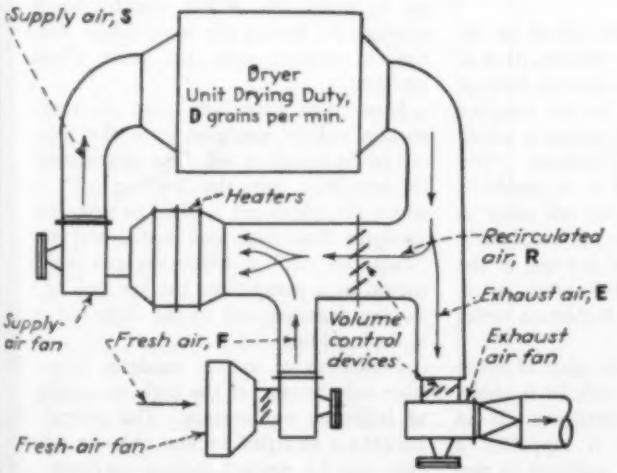
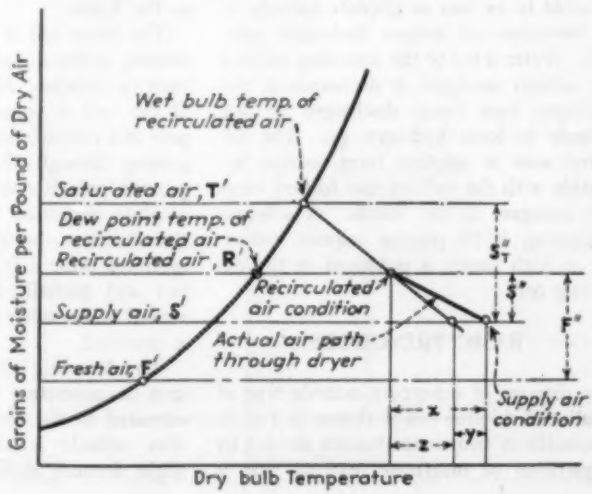


Fig. 4—Skeleton psychrometric diagram showing a typical drying problem using recirculated air. The dry bulb temperature drops are as follows: x = total drop through dryer; y = drop due to sensible heat load; z = drop due to latent heat load, i.e., evaporation of water


Wet bulb temp. of recirculated air
Saturated air, T'
Dew point temp. of recirculated air
Recirculated air, R'
Recirculated air condition
Supply air, S'
Actual air path through dryer
Fresh air, F'
Supply air condition
Grains of Moisture per Pound of Dry Air
Dry bulb Temperature

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Basic Principles and Operating Characteristics of MERCURY CELLS

Of the half hundred alkali-chlorine plants in this country, only four use the mercury cathode type of cell. Yet this cell, about which comparatively little has been published, has certain advantages over other designs more widely used. It produces, for instance, a caustic soda solution that needs no further purification even for the rayon trade. Attention is now being directed to basic advantages of the mercury cathode cell. Developments in the cell that are now underway will be discussed in a later article.—*Editors*

Blurred effect on some of these Castner cells is due to "rocking" motion

In the mercury cathode type of alkali and chlorine cell, brine is decomposed in one compartment, called the brine cell, between a graphite anode and a mercury cathode to form chlorine and sodium amalgam. The amalgam is transferred to a second compartment, the denuding cell, where it becomes the anode and is short-circuited to an iron or graphite cathode in an electrolyte of sodium hydroxide solution. Water is fed to the denuding cell and the sodium amalgam is decomposed, the hydrogen ions being discharged at the cathode to form hydrogen gas. The hydroxyl ions in solution form sodium hydroxide with the sodium ions formed from the amalgam at the anode. A solution containing 30-50 percent sodium hydroxide of high purity is produced in the denuding cell.

BASIC PRINCIPLES

A diagram of a mercury cathode type of alkali and chlorine cell is shown in Fig. 1. It consists of two compartments divided by a partition of insulating material that is not affected by chlorine or caustic soda. Under the partition there is a groove so that when mercury is placed on the bottom of the cell a liquid seal is formed which permits the free passage of the mercury but separates the other fluids. The mercury must be circulated from one cell to the other by some means, which is not shown in the figure.

The brine cell is constructed of an insulating material, such as concrete, that is inert to chlorine. Mercury on the bottom of the cell is connected to the negative pole of a current source by means of a bolt passing through the cell bottom. The positive pole is connected to an anode of graphite supported from the cell cover so that it is near the mercury surface. Nearly saturated brine is fed in at one end of the cell and partially depleted brine is removed at the other end. A chlorine outlet is provided.

The denuding cell can be made of either iron or concrete. The cathode is short-circuited to the sodium amalgam. If an iron cathode is used it is supported a slight distance above the amalgam to prevent the mercury from amalgamating the surface and destroying its activity. A graphite cathode can be placed in the amalgam as its surface does not amalgamate. The cathode is covered by a solution of sodium hydroxide. Water is fed continuously into the cell and pure, concentrated caustic soda overflows. Most cells try to make use of the countercurrent principle by having the most dilute solution in contact with the most dilute amalgam.

Many ways have been tried for transporting sodium amalgam from the brine cell to the denuding cell. The only successful ones have been the "rocking cell" in which the whole cell is tilted to make the amalgam flow back and forth, and the "stationary cell" in which the mercury is moved by a pump from the low end of a sloping denuding cell to the high end of a sloping brine cell.

Formation of sodium amalgam is possible only because of the high overvoltage of hydrogen on mercury. The potential between a saturated sodium chloride solution and 0.2 percent sodium amalgam is

−1.82 v. The overvoltage of hydrogen on mercury at the current densities used is about 1.30 v. The pH of the solution next to the amalgam is probably about 9 so that the equilibrium hydrogen discharge potential would be about −0.61 v. and the potential for hydrogen discharge would be −1.91 v. At the cathode, the reaction with the most positive potential takes place so that sodium instead of hydrogen is discharged.

However, hydrogen discharge always takes place to a slight extent. It is increased if (1) the sodium ion concentration gets too low, (2) the temperature becomes too high, (3) the sodium concentration of the amalgam increases too much, or (4) if impurities are present to electrolyze out on the mercury surface and there decrease the hydrogen overvoltage.

Common impurities in salt, such as calcium, magnesium and iron, alone do not cause amalgam discharge but nickel and cobalt do. Iron in brine containing either calcium or magnesium promotes amalgam discharge. Magnesium salts cause hydrogen discharge rather than calcium salts. Hydrogen discharge depends not only on the concentration, purity and temperature of the brine but on the sodium concentration of the amalgam. This, in turn, depends on the denuding cell.

THE DENUDING CELL

In the denuding cell, sodium amalgam acts as an anode and is short-circuited to a cathode, the electrolyte being sodium hydroxide solution. Reactions are as follows:

Anode: $NaHg_x - e = Na^+ + xHg$

Cathode: $H_2O + e = OH^- + \frac{1}{2} H_2$

Sufficient water must be fed into the cell to supply the cathode reaction and to carry away in solution the sodium hydroxide formed. The escape of hydrogen also exaporates water from the solution. Solutions containing 30-50 percent sodium hydroxide are made directly in the cell.

Sodium amalgam reacts with water very slowly because of the high voltage of hydrogen on the amalgam surface. It can be speeded up by placing a metal having a low hydrogen overvoltage in contact with the amalgam and the solution. This is a voltaic battery; component potentials are illustrated in Fig. 2. The driving force of the cell is the sodium amalgam anode potential, *e1*. Opposing it are the anode polarization e2, the potential to overcome the resistance of the sodium hydroxide solution e3, the hydrogen overvoltage of the cathode e4, the equilibrium hydrogen discharge potential e5, and the potential required to overcome metallic resistance e6.

Amalgam anode discharge potential is the voltage between the anode and the solution. It may be calculated from the activity of the sodium in the amalgam and the activity of the sodium ion in the solution. It is increased by (1) increasing the sodium concentration of the amalgam; (2) decreasing the sodium hydroxide concentration of the electrolyte; (3) increasing the temperature.

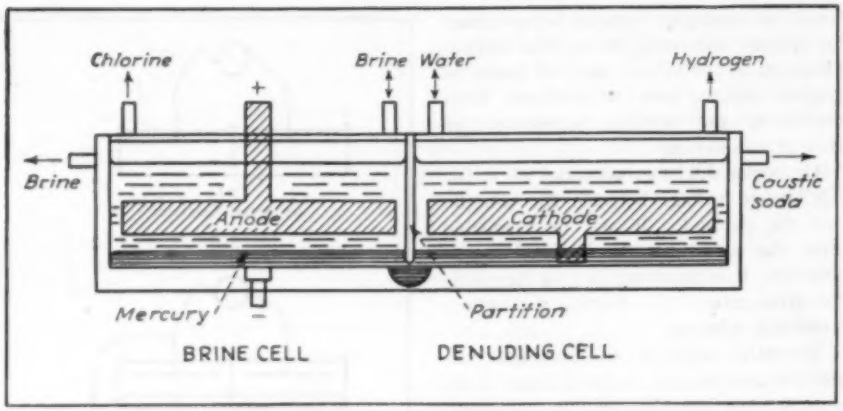


Fig. 1—Mercury cathode type of alkali and chlorine cell

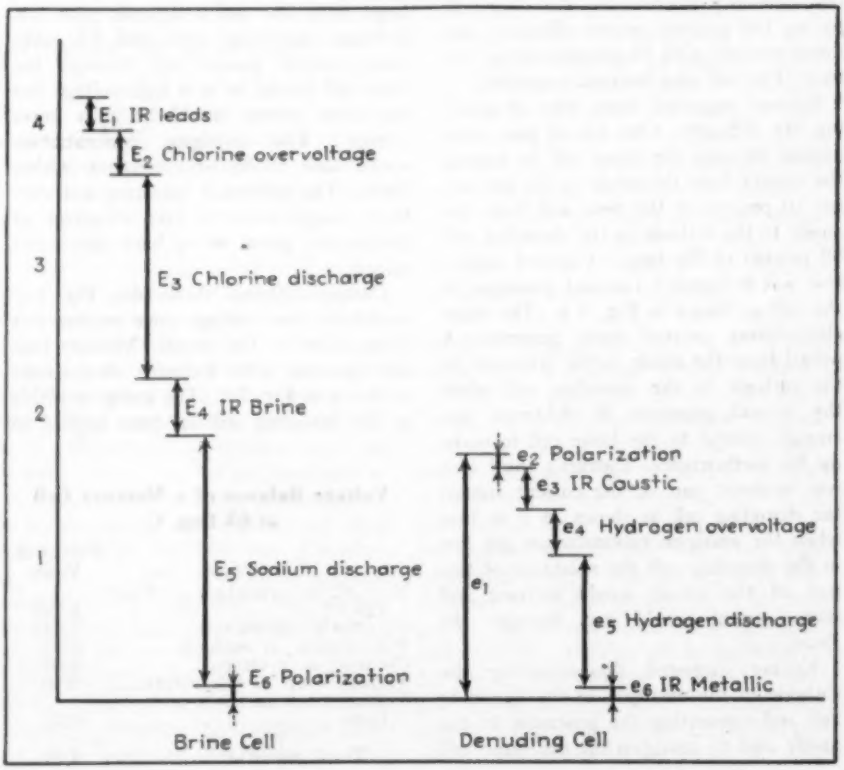
The anode polarization e2 is a small potential caused by the slow diffusion of sodium to the amalgam surface and sodium ions away from it. This potential is decreased by (1) increasing the temperature; (2) decreasing the sodium hydroxide concentration; (3) decreasing the current density.

Potential required to overcome the resistance of the electrolyte e3 increases directly as the distance between the anode and cathode and inversely as the cross-section of the electrolyte. It is at a minimum for approximately 19 percent caustic solution. It decreases with increasing temperature.

Hydrogen overvoltage, e4 is characteristic of an electrode surface. For a given surface, it is decreased by (1) increasing the temperature; (2) decreasing the current density.

Surface overvoltage after long continued electrolysis is the important value. Very minute impurities in the electrolyte deposit on the cathode. A metallic cathode, such as one of iron, must be placed an appreciable distance away from the amalgam surface or it will rapidly become covered with mercury and become inoperative. Cast iron shows the least tendency of the common metals to become coated but it fails eventually and must be replaced. The surface activity may be renewed by allowing it to rust. Graphite has a higher overvoltage than some of the metals but it can

Fig. 2—Voltage components of a mercury cell



touch the amalgam without being coated by mercury and losing its reactive surface. One type of cathode is made of pieces of graphite dipping into the amalgam. Both electrolyte and metallic resistances are then at a minimum.

Hydrogen discharge potential e5 is the equilibrium voltage between the solution and the electrode. It may be calculated from the activity of the hydroxyl ion in solution. It is decreased by (1) increasing the temperature; (2) diluting the sodium hydroxide solution.

Potential required to overcome the metallic resistance e6 is the product of the current and the sum of the resistances through the amalgam sheet, the cathode and any contact resistance between the two.

Practical considerations require a concentrated sodium hydroxide solution and a dilute amalgam so the cell must be designed with the opposing potentials at a minimum. This is obtained by (1) exposing a large surface to decrease the anode and cathode current densities; (2) placing the two electrodes as close as possible; (3) choosing a cathode with a low overvoltage; (4) by operating at a high temperature.

MERCURY CELL VOLTAGE

The original idea of the mercury cell was to have mercury act as an intermediate electrode, the current being passed from the anode in the brine cell to the cathode in the denuding cell. This hook up is illustrated in Fig. 3 a. When this was tried, the brine cell had only about 90 percent current efficiency whereas the denuding cell, having 100 percent current efficiency, oxidized mercury with 10 percent of the current. The cell soon became inoperable.

Castner suggested three ways of avoiding this difficulty. One was to pass more current through the brine cell by passing the current from the anode to the mercury for 10 percent of the time and from the anode to the cathode in the denuding cell 90 percent of the time. A second suggestion was to connect a second generator to the cell as shown in Fig. 3 b. The main electrolyzing current from generator *A* passed from the anode in the brine cell to the cathode in the denuding cell while the second generator *B* delivered just enough current to the brine cell to make up for inefficiencies. Castner's third idea was to shunt part of the current around the denuding cell as shown in c so that when the amalgam concentration got low in the denuding cell the resistance of this part of the circuit would increase and more current would pass through the shunt.

Kellner suggested short-circuiting the cathode to the amalgam in the denuding cell and connecting the generator to the anode and to amalgam on the brine cell side, as shown in Fig. 3 d. Castner's first two ideas were to utilize the potential available in the denuding cell to decrease the cell voltage. Castner's external shunt shown in c and Kellner's internal short-circuit are essentially the same. Neither attempts to utilize the potential available in the denuding cell.

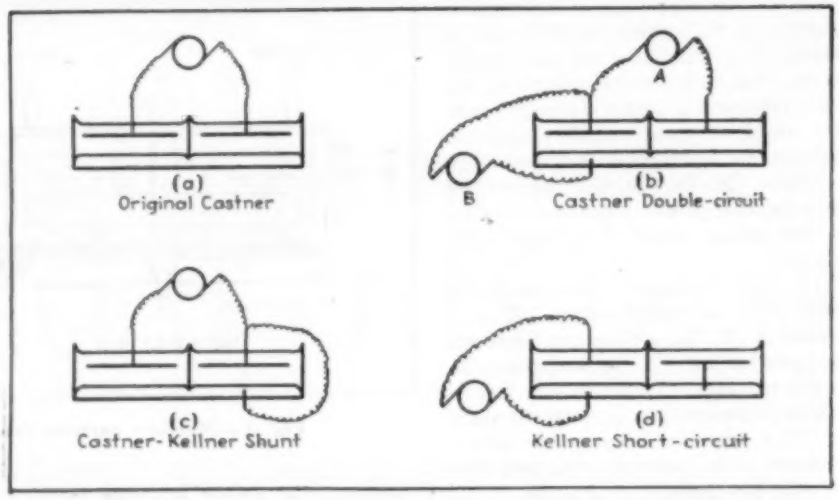


Fig. 3—Castner suggested three means of avoiding early difficulties

The potential between a platinized platinum anode in 25.5 percent sodium chloride solution and a platinized platinum cathode in 30 percent sodium hydroxide solution with an intermediate electrode of 0.02 percent sodium amalgam is 2.29 v. at 65 deg. C. The potential between the same anode and sodium amalgam is 3.07 v., a difference of 0.78 v. Castner's first two schemes would save power if the resistance drops were low and a cathode with low hydrogen overvoltage were used. The additional current passed only through the brine cell would be at a high voltage but the main current would be at a lower voltage. The amalgam concentration would have to be held constant within limits. The additional operating and electrical complications to take advantage of the possible power saving have never been solved.

Castner's external shunt idea, Fig. 3 c, would not save voltage since resistance is being added to the circuit. Mercury cells are operated with Kellner's short-circuit as shown in Fig. 3 *d*. The energy available in the denuding cell has been applied to making a more concentrated sodium hydroxide solution.

The mercury cell has a fundamental disadvantage over the diaphragm cell of about 0.78 v. There is no diaphragm to impose a resistance and the electrodes can be set closer together but the cells are operated at 2-6 times the current density. Thus mercury cells have a higher voltage than diaphragm cells. A cell operating with a current density of 1 amp. per sq.in. (0.155 amp. per sq.cm.) at 65 deg. C., with 25.5 percent sodium chloride and 0.02 percent sodium amalgam would have a voltage balance approximately as shown in the accompanying table and illustrated in Fig. 2. The cell voltage is decreased by (1) increasing the temperature; (2) increasing the sodium chloride concentration; (3) bringing the electrodes closer together; (4) decreasing the current density; (5) decreasing the amalgam concentration.

Voltage Balance of a Mercury Cell at 65 Deg. C.

Constituent	Potential, Volts
Na (.02% amalg.), NaCl (25.5%)	1.738
Cl_2, NaCl (25.5%)	1.334
Polarization at cathode	0.02
Chlorine overvoltage	0.30
Voltage drop in electrolyte	0.40
Voltage drop in leads and contacts	0.25
Total potential	4.04

Since the mercury is in competition with the diaphragm cell, the energy or power efficiency is on the basis of a theoretical decomposition voltage of 2.3 v. so that

$$\text{E. E.} = \frac{2.3 \times \text{C.E.} \times 100}{\text{Operating voltage}} = 52\text{-}55 \text{ percent.}$$

PROCESS FLOWSHEET

A flowsheet of the mercury cell process is shown in Fig. 4. Filtered saturated brine is fed to the brine cell at approximately 1 ml. per min. per amp. of cell current although no appreciable change in operation occurs until the rate is reduced to 0.3 ml. per min. per amp. Brine flows out of the cell and is resaturated by the addition of solid salt. The resaturated brine is settled and filtered before returning to the cell.

Depending on the quality of salt used, impurities in the brine are kept down by periodically purging part of the brine. Since this is saturated with chlorine, all parts of the circulation system must be of resistant material such as concrete, hard

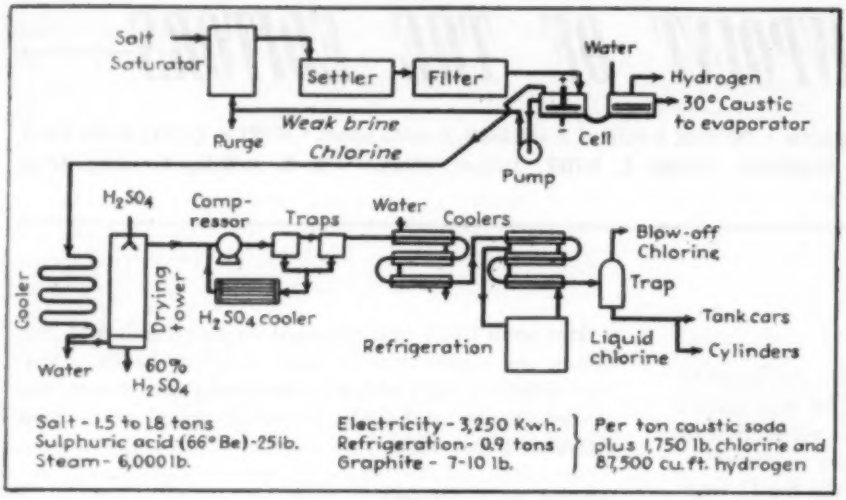


Fig. 4—Flowsheet of the mercury cell process for alkali and chlorine

rubber or the like. All pieces of equipment must be covered to prevent chlorine escaping into the atmosphere. The denuding cell is fed with pure water at such a rate that the desired concentration of sodium hydroxide, usually 30-50 percent, overflows at an outlet. This solution is very pure and only requires the evaporation of water, which is carried out in simple nickel-lined evaporators up to 70 percent and then in direct-fired, nickel-cast-iron pots to the anhydrous state.

Chlorine from the mercury cell is handled similarly to that from the diaphragm process except that it must be diluted with sufficient air so that the hydrogen in the blow-off chlorine is brought below the explosive limit.

The mercury cell will operate efficiently at current densities up to 3 amp. per sq.in. and possibly higher so that a very wide current variation is possible. For variations in current, the rate of brine feed can be left unchanged but to maintain a constant concentration of the sodium hydroxide solution, the rate of water feed is varied.

Best indication of cell operating conditions is the amount of hydrogen in the chlorine. This is determined periodically. The performance of individual cells is checked by analysis of the amalgam and by the specific gravity of the sodium hydroxide produced with constant water feed. The quality of the brine must also be maintained by analyzing for such variables as chlorate, sulphate and magnesium.

Cells must be periodically cleaned to remove graphite particles and impurities that tend to gather on the cell bottom and around the mercury seals separating the compartments, thus interfering with the flow of mercury. During this operation, anodes are adjusted or discarded and cathodes in the denuding cell are inspected and replaced if necessary.

PRODUCT PURITY

The purity of the caustic soda produced is the outstanding characteristic of the mercury cell. Calcium and magnesium, if present as impurities in the brine, are deposited in the mercury and thus appear in the caustic soda by electrolytic action. Minute quantities of brine can creep through the mercury seals but this has been eliminated by modern cell designs. Other impurities appearing in the product enter with the water or are picked up in handling the caustic soda after it leaves the cell. Nickel equipment has been found most satisfactory for handling caustic soda to prevent contamination. Typical analyses of caustic soda are given in an accompanying table.

Analyses of Mercury Cell Caustic Soda

	Percent	
NaOH	50.0	
Na_2CO_3	.04	— .2
NaCl	.002	— .08
Na_2SO_4	.001	— .01
SiO_2	.003	— .01
Fe	.0001	— .0002
Al_2O_3	.0005	— .0006
CaO	.0001	— .0002
MgO	.00015	— .0003
Ni	.00001	— .00002
Mn	.00001	— .00002
Cu	.00001	— .0001

Cost of Producing Synthetic Rubber Is Revealed

THE costs of production being realized in the synthetic rubber plant reflect the varying costs of ingredients which are attributable to wartime conditions the Rubber Reserve Co. announced in its "Report on the Rubber Program 1940-1945." The following analysis is based on plant costs, exclusive of Washington administrative expense, interest, research expense, plant amortization, and sales expense. Since plants are operated for government by private companies, a charge has been included in most cases to cover home office management expense. Allowance has been made for the payment of royalties at rates which are lower during the war period than they will be postwar.

Principal element in the cost of producing GR-M (neoprene) is the price paid for acetylene. Using present prices of 11.5 to 12c. per lb., GR-M is being produced at a cost of 23 to 24c. per lb. Based on a probable postwar acetylene price of 6 to 7c. per lb., it is reasonable to expect that GR-M may be produced for cost of about 19c.

Cost of producing GR-I (butyl) rubber was about 13 to 18c. per lb. during the last quarter of 1944 when operating rates of 50 to 80 percent of rated capacity were being realized. Higher production rates and lower costs are expected during the coming year.

There are three factors which must be considered in arriving at the cost of producing GR-S, namely the cost of butadiene, the cost of styrene, and the cost of converting these two into GR-S. The cost of producing these chemicals has varied widely, depending upon the feedstock, but during 1944 has averaged 33c. and 10c. per lb., respectively. Conversion costs are currently reported in the neighborhood of 4.9c. per lb. for synthetic rubber. Thus the present average cost of producing GR-S is 30 to 31c. per lb. The costs of producing GR-S at a project which is supplied exclusively with butadiene and styrene manufactured from petroleum feedstocks were 11 to 12c. per lb.

Estimates of postwar prices for butylene and for industrial alcohol are subject to controversy. However, assuming that butylene can be purchased for 6 to 8c. per gal. as a raw material for butadiene, it is estimated that GR-S can be produced for a cost of 10c. per lb. Likewise, assuming that alcohol prices to the synthetic rubber industry will be in the range of 15 to 25c. per gal., it is estimated that GR-S can be produced therefrom for a cost of 11 to 14c. per lb. The quantity of rubber which can be produced at these costs levels is, of course, limited by the quantity of low-priced feedstock available.

The styrene plants have operated steadily at high production rates. The cost of the styrene produced is largely a function of the prices of the two principal feedstocks, benzene and ethylene. At present, with benzene at about 16c. per gal. and ethylene at 6c. per lb., styrene costs of 6 to 7c. per lb. are being obtained. Two plants are producing their own ethylene by the dehydration of alcohol, which results in substantially higher cost for ethylene and increases the cost of styrene to 12 to 14c. per lb. In postwar operation it has been estimated that ethylene will be available at 3c. per lb., and benzene at 8 to 12c. per gal. Based on these prices it should be possible to produce styrene for an out-of-pocket cost of 4 to 5c. per lb.

FROM THE VIEWPOINT OF THE EDITORS——

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PACIFIC PROCESS INDUSTRIES

As a nation we have turned our eyes, hearts and hopes to the West. The fighting war that must still be won against a fanatical enemy calls for sustained high production of many chemicals and allied materials. There is, therefore, increasing interest in the process industries of the 11 western states, the problems they are facing as well as the progress being made in their solution.

Recognizing that these western developments are of national as well as local concern. *Chem. & Met.* has greatly extended its editorial contacts in this important area. For more than a year, one of our senior editors has given his entire time to this work. His services have been supplemented by those of the Pacific Coast News Bureau of the McGraw-Hill Publishing Co., with headquarters in San Francisco and correspondents in the principal western cities. Through their combined efforts, we are privileged to publish a new editorial department in this magazine.

Beginning this month on page 156 is the first instalment of "Pacific Process Industries–Trends, Events, Developments." It will continue as a regular feature as long as it serves your needs and interests. John R. Callaham, associate editor in San Francisco, will welcome comment and criticism as well as cooperation and support.

A SINGLE HARDNESS SCALE?

Hardness of materials is variously defined, depending on the kind of material, the kind of hardness, and unfortunately, often principally according to the prejudice or preference of the individual making the definition. There are many kinds of hardness of industrial materials, each of which deserves separate definition. But there is no comparable excuse for the wide variety of indexes of hardness, many of which presume to refer to an identical property of materials.

There is now available a possible means for escaping some of this confusion with reference to indentation hardness. Work at the National Bureau of Standards seems to indicate that a single scale of indentation hardness can be used for a great variety of industrial materials ranging from pitch up to diamond. On this scale pitch might be rated between 1 and 20 indentation units, whereas the diamond would be rated 8,000 to 8,500 in hardness. The method is applicable to all classes of metals as well as to non-metals and minerals.

Apparently some reasonable scientific coordination can be had between these hardness numbers and the real use characteristics of the materials tested. One cannot expect that everyone is going to throw away Brinell, Vickers and all the other well known hardness test methods and scales. In fact one might anticipate that the metallurgists will resist any attempt at standardization or simplification. But it does seem likely that chemical engineers will find usefulness and significance for some such new hardness testing method as that which is now being used extensively at the Bureau of Standards and is described in their Research Paper 1220.

BACK PAY SUITS

Certain legislative measures have been proposed to limit the time within which penalty suits for back pay can be brought under Federal laws. The Supreme Court has in effect decided that an individual worker may not sign away his right to such suit under the Wage-Hour Law or under other overtime pay statutes. Thus it becomes of great importance to have all such matters clearly defined by law with a limit on the time during which such suit may be entered.

The Judiciary Committee of the House of Representatives has been holding hearings on certain legislation which proposes a limit of two years for public action and one year for private suit under such laws. A considerable number of industrial groups are backing this measure. Regardless of whether one likes the particular bill or not, it is important that everyone give support to this broad idea. Otherwise the cumulative effect of wage suits might be enough to bankrupt even a strong enterprise should there suddenly develop a campaign among disgruntled workers. The result would not be prosecution, but a most vicious sort of persecution of industrial enterprise. Such limitation will not prevent justice for the individual; it will merely protect companies against claims that have been deferred unreasonably long.

TWO GROUPS WITH ONE JOB?

Important companies in the fertilizer industry have recently completed the organization of the American Plant Food Council. A major announced purpose of this new association is to work against the entry of the Government into the fertilizer business in competition with private enterprise. There can be no doubt that the industry must work for this objective. The threat of the Government to become a competitor has never been more evident than in the proposed legislation S. 882, which would authorize several types of subsidized governmental activity. Furthermore, certain Government and farm groups of leftish leanings are building up throughout the states strong political groups in an effort to support such governmental activity. Industry cannot safely sit by; it must defend itself against these un-American efforts which amount almost to state socialism.

As one commends the essential efforts of defense it is almost inevitable that one recognize also the unfortunate fact that the fertilizer industry is now divided in its

trade organizations. National Fertilizer Association has long undertaken to serve the purposes described as the objectives of the new organization, viz: (1) investigational and educational work leading to increased and more effective use of fertilizers and (2) vigorous opposition of government entry into fertilizer manufacture or distribution in competition with private enterprise. It remains to be seen whether two groups working simultaneously for the same objectives will be as effective as one organization including all the membership of both.

LET'S FIX THOSE LABELS!

MANUFACTURING CHEMISTS' ASSOCIATION has given the chemical industry a clear and simple description of the way in which labels should be prepared for any chemical having any potentially hazardous properties. In its new Manuals L-1 and L-2, MCA for the first time reduces to a simple clear form the basic definitions of label making, supported by several illustrations of product caution labels.

The next step in the protection of the public is that every company shall review its own labels to bring them in harmony with these sound definitions. There is good promise that such practice will not only promote safety but will also prove profitable.

UEBER ALLES?

ONE more myth of Germany's well advertised superiority in chemical matters has been exploded by the reports of the mission of American technologists who inspected the buna plants and laboratories prior to V-E day. Despite the Germans' head start of many years in research and their vaunted achievements in getting into commercial production, they fell far short of meeting our output in either quality or quantity. Based on the findings of the technical mission headed by Russell Hopkinson of United States Rubber Co., John Collyer of WPB and Stanley Crossland of Rubber Reserve are authorities for the statement that "The United States and its allies could not have produced tires, tubes and other rubber products in sufficient volume and of adequate quality to maintain the armed forces and a civilian economy if they had to rely on the type of rubber produced by the Germans."

Although the German synthetic rubber plants had a total rated capacity of 170,000 tons a year, the records obtained by our investigators showed that their actual production never exceeded 110,000 tons a year. Contrast that with our industry which in two years established a rated capacity of 850,000 tons and in 1945 will actually produce almost a millions tons. In fact the most recent report of the Rubber Reserve Co. (see p. 113) shows that scheduled production for 1946 is set at 1,200,000 tons which is more rubber than the entire world consumed in any one year prior to 1941.

French and Belgian tire plants that used buna during the occupation of their plants by the Germans, have reported that American GR-S is more satisfactory in all respects. The French found that fabricating capacity was reduced 50 percent for end products because the German synthetic had to be softened by heat before compounding and in other ways was more difficult to utilize.

The technical mission included in addition to Russell Hopkinson, J. D. Fennebresque, Celanese Corp.; B. S. Garvey, B. F. Goodrich Co.; E. T. Handley, Firestone Tire and Rubber Co.; R. D. Juve, Goodyear Tire and Rubber Co.; J. W. Livingston, Rubber Reserve Co.; Dr. Carl L. Monrad, Carnegie Institute of Technology; A. H. Nellen, Lee Tire and Rubber Co.; R. D. Schatzel, General Cable Co.; J. E. Troyan, Phillips Petroleum Co.; and W. L. White, Raybestos-Manhattan Co. Our investigators were fortunate in locating and interviewing Germany's key personnel, inspecting the plants and studying many original records and documents. The information and data so obtained are now being made available through official sources to authorized companies.

Meanwhile, all American chemical engineers can find satisfaction in the concluding sentence of the Collyer-Crossland statement: "There is no indication that German synthetic rubber techniques will be of material help to the American rubber industry because our present processes are superior in so many respects."

AMMONIA FOR SPEED BOATS?

CHEMICAL makers must acquaint themselves with a wide variety of human activities. There is nothing new in the thought that the postwar planning of most companies is vastly more complicated than ever before.

One example of this is found in the problems faced by the owners or operators of synthetic ammonia plants. Chemical engineers of such firms now find themselves concerned with the future of speed boats, problems of ready-cut or pre-fabricated houses, and a dozen other new activities that seem to have nothing to do with ammonia. This interest comes from the necessity of determining whether some of an ammonia plant should not be converted to the manufacture of methanol. Such methanol will find a major application for formaldehyde to be used in plastic bonding of plywood for small boat and house construction, among other things.

MUST DEATH BEGIN AT 40?

INDUSTRY in general, and the chemical industry particularly, may point with justifiable pride to the splendid records that have been made in reducing the number and severity of its accidents. But in concentrating its efforts in this direction, has it not overlooked the cases of the key men in their mid-forties who have been crumpling due to organic failures often times tripped off into tragedy by some identifiable condition of the job itself?

Elsewhere in this issue the dramatic story is told of a very large chemical company which lost the services of eleven of its engineers, superintendents, and executives in recent years. The strain of war cannot be entirely to blame because the company's prewar record was equally bad in this direction. These cases are not a direct responsibility of the medical, safety, research or personnel departments. Most of them would probably ignore the problem until such time as management may get out a new organization chart. The real solution is to plug the gap by something more than periodic health check-ups.

We are inclined to believe, with our author, that in too many companies the fine records achieved in their plants have made management so complacent as to feel that there are no further safety frontiers to explore. In reality some of the most serious causes of "accidents" may have been overlooked. This problem is a challenge to management that it can no longer afford to let go unsolved.

CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

$50 WAR BOND FOR A GOOD IDEA!

Until further notice the editors of *Chem. & Met.* will award a $50 Series E War Bond each month to the author of the best short article received during the *preceding* month and accepted for publication in the *Chem. & Met.* "Plant Notebook." Articles will be judged during the month following receipt, and the award announced in the issue of that month. The judges will be the editors of *Chem. & Met.* Non-winning articles submitted for this contest may be published if acceptable, and if published will be paid for at space rates applying to this department.

Any reader of *Chem. & Met.*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

JUNE WINNER!

A $50 Series E War Bond will be issued in the name of

CHESMAN A. LEE

Engineer, Darling & Co.
Chicago, Ill.

For an article dealing with the repair of a main load-carrying column in a mill type building, which has been adjudged the winner of our June contest.

This article will appear in our August issue. Watch for it!

May Contest Prize Winner

HOW CARBON RINGS SAVED $114 PER YEAR IN A TROUBLESOME CENTRIFUGAL PUMP PROBLEM

WARD E. PRATT
Manager, Chemical Section
Worthington Pump & Machinery Corp.
Harrison, N. J.

PUMPING hot acid with abrasive solids in suspension is a severe service, and high-maintenance costs are sometimes unavoidable. Usually the stuffing box requires the most frequent attention due to a combination of corrosion and wear at a point of pressure and generated heat, i. e., the bottom of the box where the slurry becomes impregnated in the packing rings.

Theoretically, if an independent water seal is used, the material being pumped is kept out of the packing area, and the stuffing box operates under "water pump" conditions. However, if an operator fails to keep the water seal pressure on at all times, even during shut-down periods, the abrasive solids may enter and imbed in the packing so that the next time the gland is tightened an effect is brought about which is similar to wrapping a piece of emery cloth around the shaft. Rapid wear and disintegration of packing results.

Fig. 1 shows an impeller from an Antaciron (high-silicon iron) pump which was handling an abrasive slurry in a hot sulphuric acid solution. The Antaciron shaft shroud has been worn clear through in the area contacted by the last two rings of packing although the impeller itself would otherwise have been useful for many additional months. It is obvious that in the last stages of use the packing maintenance was costly.

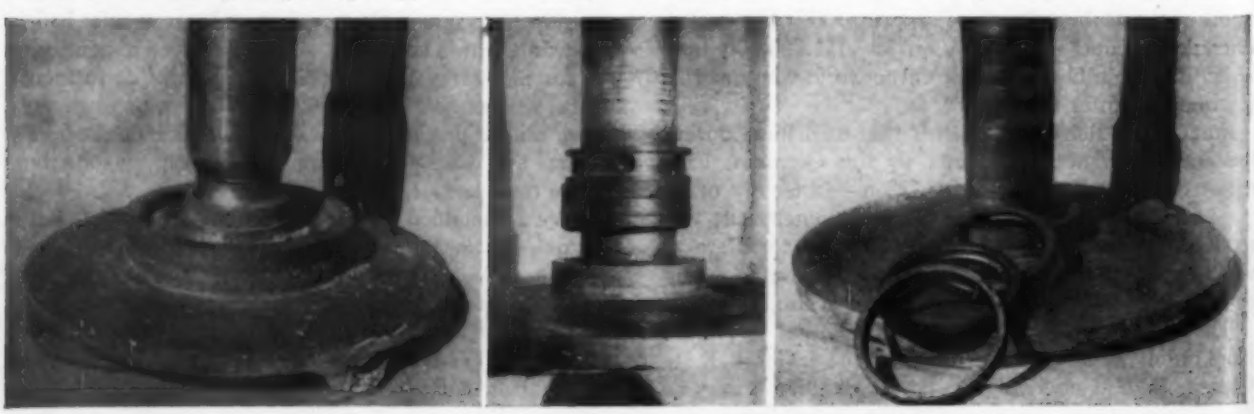
PREVENTING CONTACT

The problem here was to bring about a condition which would prevent any contact between the bottom rings of packing and the shaft shroud, which is an integral part of the impeller. This could be accomplished by the use of "packing rings" in which the solid abrasive particles could not imbed themselves and which could not be compressed against the shaft by gland

Fig. 1—Antaciron pump impeller showing wear on shaft shroud caused by abrasive acid slurry becoming imbedded in bottom two rings of packing

Fig. 3—Antaciron pump impeller showing assembly of three carbon rings adjacent to water seal cage (lantern ring) on shaft shroud

Fig. 4—Antaciron pump impeller showing how use of carbon rings protected shaft shroud from wear by abrasive slurry during nine months service



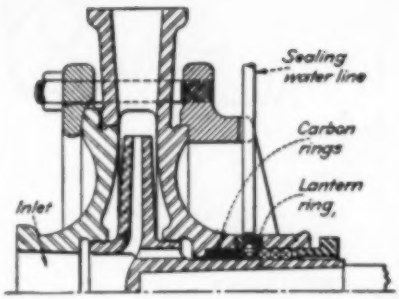


Fig. 2—Cross Section of an Antaciron pump showing how the carbon rings are installed in the stuffing box before the lantern ring

tightening. Since the pumping operation could tolerate a considerable amount of dilution from the water seal, there was no objection to using a water seal to flush out the annular space between the incompressible packing rings and the shaft.

Carbon rings were obtained which fitted the inside of the stuffing box snugly and allowed only a few thousandths of an inch clearence around the Antaciron shaft shroud. These were inserted between the water seal cage (lantern ring) and the bottom of the box. Location of the carbon rings may be seen in Fig. 2 which shows a partial cross section of an Antaciron pump. Fig. 3 shows these carbon rings in position on the shaft with the water seal cage.

Fig. 4 shows the condition of a shaft shroud and the carbon rings after nine months of operation in the same corrosive-abrasive slurry service. The carbon rings have been partially gouged out on the inside surfaces due to the swirling of the slurry at some time before the water seal was turned on sufficiently to flush it out into the pump. The shaft shroud is nearly as good as new. It is interesting to note that apparently the solid particles never got back into the asbestos packing between the seal cage and the gland as this area on the shaft shroud is only polished.

NO MAINTENANCE

During the nine months operating period of the impeller shown in Fig. 4 there was no maintenance on the pump and no packing was added. During the operating period of the impeller shown in Fig. 1 frequent shut-downs for repacking were necessary and then a new impeller was required. When this experiment was started no attempt was made to keep accurate records for comparative costs, but the savings were so obvious that this company has adopted the general use of carbon rings for all slurry pumps where the amount of seal water entering the pump is of little or no importance. The pump manufacturer now carries these carbon rings in stock for such applications.

An estimate of savings by the use of the carbon "packing rings" in this manner, as approved by the plant superintendent, is as follows:

For the pump as shown in Fig. 1 the costs were: 1½ impellers per year, totalling $160.93; 12 sets of packing per year, totalling $43.80; and installation cost for the 12 packings, at $18 total, giving a grand total for the year for maintenance on this pump of $222.73; For the pump equipped as in Fig. 4 the deterioration amounted to ¾ impeller per year, at $90.50; while installation of a set of carbon rings plus three rings of regular packing came to $8.03 for materials, and $10 for labor, totalling $108.53. Thus the use of carbon rings saved $114.20 per year.

It is to be noted that hard lead rings were not satisfactory when tried in the same manner as the carbon rings. Apparently crystallization on the lead occurred during shut-downs, and gouging and distortion occurred causing binding. Carbon seems to be preferable to any kind of metal ring for this type of application, especially as corrosion and scoring are eliminated as factors in performance.

DETERMINING FLOW FROM OPEN END PIPES

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A SIMPLE METHOD for determining flow from open end pipes is sometimes used by civil and hydraulic engineers, as well as others, for estimating the discharge from hydrants and nozzles. Not so well known to chemical engineers, the method is extremely useful in checking on the delivery of pumps for recirculating service, and similar purposes. The method is an adaptation of the law of falling bodies and consists in measuring the distance x that a horizontal discharge travels in dropping through a distance s, as shown in Fig. 1.

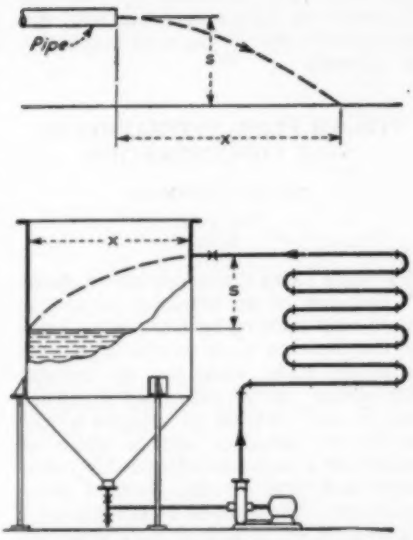


Fig. 1—Relation between pipe size, fall and horizontal distance of stream gives discharge rate

Fig. 2—Method is especially useful for determining discharge of a pump recirculating tank contents

By using the formula for freely falling bodies, $s = \frac{1}{2}\ at^2$, and taking velocity as distance/time, the following general formula can be derived:

$$Q = 2.448\ D^2\ x\ /\ \sqrt{2s/g}$$

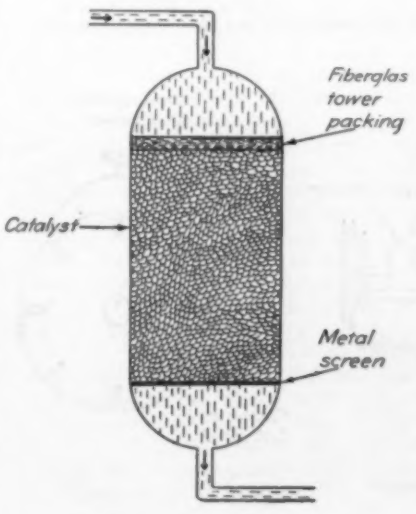
where Q is the discharge rate, g.p.m.; D is the diameter of the pipe opening, in inches (use the smallest diameter if there is a *vena contracta*; s is the vertical distance in feet through which the stream falls from the center line of the horizontal pipe to the ground or floor level, at the point where the stream strikes; x is the horizontal distance, in feet, from the end of the pipe to the center point of contact of the stream with the ground or floor; and g is the gravitational constant, 32 ft. per sec. per sec.

This system is mathematically correct and its accuracy depends only on the usual limits of gravitational devices, and the accuracy with which the variables can be measured. Where possible to do so the computations can be simplified by keeping $s = 1$ ft. For example:

It is desired to calibrate a centrifugal pump working against several discharge pressures. The discharge pipe, containing a pressure gage and a throttle valve, is set up to discharge horizontally 1 ft. above the floor. At 30 lb. gage pressure $x = 4$ ft. Then $Q = 2.448 \times 1^2 \times 4/(2/32)^{1/2} = 39.2$ g.p.m. At 20 lb. gage pressure, $x = 6$. Then $Q = 2.448 \times 1^2 \times 6/(2/32)^{1/2} = 58.75$ g.p.m.

A particularly useful application of this system is illustrated in Fig. 2. Here it is desired to measure the delivery of a large recirculating pump which discharges horizontally into a tank. The simplest method is to lower the level of the liquid in the tank while the pump is operating until the stream just hits the opposite

Atlantic Refining Co. at Philadelphia was having trouble with fouling of a catalyst bed by iron sulphide, scale, coke and carbon particles carried in an oil vapor stream. It was found that a 3-in. layer of Fiberglas tower packing placed on the catalyst so decreased the fouling that the length of run was more than doubled between cleanings, and it was the need for catalyst regeneration that became the determinant



side of the tank. Since the pipe and tank diameters are known and the level can be measured readily, the discharge is easy to calculate.

STREAM FLOW ESTIMATION BY SALT CONCENTRATION

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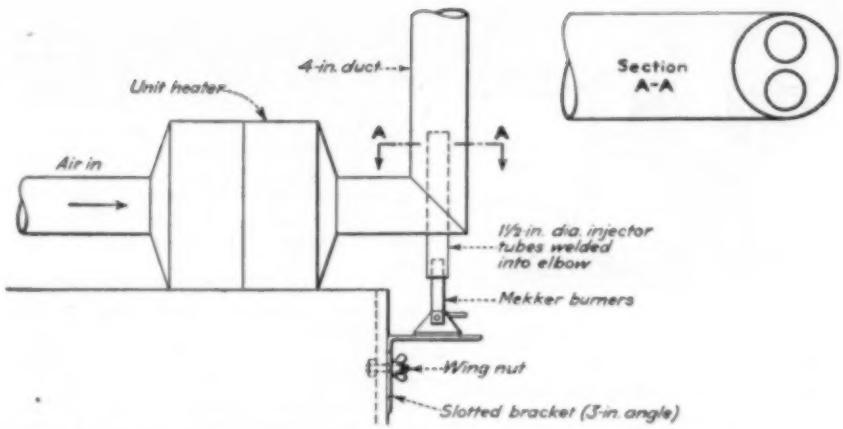
Tenn.

IN SOME CASES the calculation of stream flow can be an expensive proposition when weirs must be built or contour maps of the river bed made to coordinate with a check made with the conventional stream-flow speed indicator. A much simpler and certainly as accurate a plan is the salt saturation method which requires but a minimum of outlay in equipment and time for the chemical determination. The pounds of salt passing a given point per second on the downstream side of the feeder must equal the sum of the pounds of natural salt carried by the stream and the pounds of salt added by the distributor; or $W\,R + W'\,R' = (W + W')\,R''$. The values of the R's being known by analysis, the equation may be solved for W. The value R is included in the equation since many streams carry much natural salt. To omit it may mean serious errors in the computation.

USING THE METHOD

Method: Let W represent pounds of water discharged per second in the stream; W', pounds of salt added per second by the distributor to the stream; R, the percentage of natural salt (by weight) that flows in the stream; R', the percentage of salt in the mineral fed through the distributor; and R'', the percentage of salt in the samples taken after thorough mixing has taken place in the stream bed between the point where salt is distributed and the sampling station.

This machine is quite simple in design and is easily fashioned in the average shop from cast off materials by the shop staff. The quantity of salt to be fed is easily changed by adding or removing the steel segments from the periphery of the feed disk. These are attached by means of flat headed steel bolts that drive down into tapped holes in the disk. The power is furnished by means of a fractional horsepower motor driving the speed reducer by means of a V-belt drive. The speed rate can be changed by altering the number of segments in place; the r.p.m. of the speed reducer; the size of the pulleys; or by selecting a motor with a speed controller, so that the quantity can vary from zero to 500 g. per min.



To boost air temperature from unit heaters, gas burners were used as shown in the duct to mix their combustion products with the air

BOOSTING TEMPERATURE WITH GAS BURNERS

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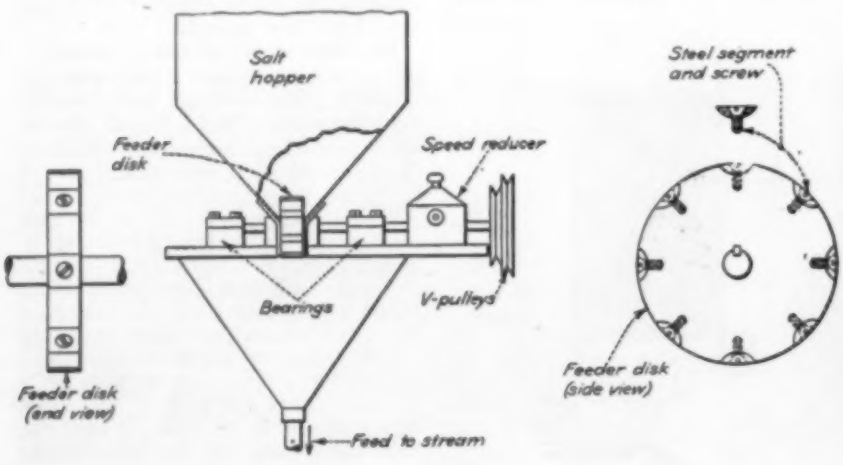
IN USING unit heaters equipped with steam coils to heat a stream of air for process purposes, difficulty is often encountered because of limitations imposed by the steam pressure available and the relatively low heat-transfer coefficient from the coils to the air.

With two unit heaters mounted as shown in the drawing, and using 100 lb. per sq. in. steam in the coils (328 deg. F.), the ultimate air temperature at the point of use was found to be only 250 deg. F., with moderate air flow rates. To boost the air temperature, two 1¼-in. diameter sheet metal tubes were welded into the 4-in. sheet metal elbow shown. Two Mekker burners were mounted side by side on an angle iron bracket, and slots were cut into the other angle of the bracket to permit moving the burners readily up and down inside the tubes. Two wing bolts served to hold the bracket to the supporting frame.

The tubes should extend at least 1 ft. into the elbow as the air flow is turbulent at the bend and the burner flames will blow out if the tubes are too short. Using this arrangement, with the hot burner gases providing direct heat input, an air temperature of 450 deg. F. at the point of use was attained, or a better than 50 percent improvement. The method is economical and simple, and the full heat content of the gases, of course, goes into the air stream.

A simple test for static conductive belts is desirable, since their conduction should be tested at intervals, say monthly. The B. F. Goodrich Co. has worked out the test shown here, using two metal blades with insulated handles in series with a 110-volt, 2-watt neon light. In use the points of contact are wetted, with a dry section about a foot long between contact points. If the bulb lights, conduction is still sufficient

Simple home-made feeder for salt for use in salt concentration flow measurements



REPORT ON.....

Methods That Offer New Tools for PROCESS CONTROL

Several techniques formerly used mainly for research purposes have been moving during the War years into plant control applications, for the rapid analysis of process mixtures. Analyses that formerly required hours or even days by customary chemical laboratory procedures have been yielding to certain advanced tools of the physicist which achieve results far more expeditiously, often in a matter of minutes. Among these are spectroscopy in the ultra-violet, visible and infra-red regions, X-ray and electron diffraction, mass spectroscopy, electron microscopy, and a few other methods. One or two of these means have already been applied to automatic recording or even automatic control and eventually others also may be made automatic.

Most plant operations depend on routine analysis of process mixtures to give as quickly as possible, and as often as may be needed, an answer to the all-important question of "What *is* this material, anyway?" In addition to the methods of the laboratory, there are numerous satisfactory devices for determining the concentrations of solutions and the analyses of simple mixtures, most of which have been described frequently in the literature (e.g., *Chem. & Met.*'s Process Control issue, May, 1943). Usually these are based on the measurement of physical properties such as thermal or electrical conductivity, specific gravity, viscosity, consistency, dielectric constant, heat capacity or optical rotation. A necessary factor in the analysis of fuel gases is calorific value. Hydrogen ion concentration is often a suitable measure. These methods, in general, are readily mechanized for recording and also for automatic control, if desired. Actual analysis may also be simplified and systematized, and can be made automatic if necessary, as in manual and automatic Orsat analyzers.

Such means as these, coupled with ordinary laboratory analysis, have been and will continue to be perfectly adequate in a great many cases, probably in the majority of cases. They have been less than adequate, however, with some of the complex organics, which usually require many hours for analysis by chemical methods. The necessities of War, especially for high octane gasoline, synthetic rubber and its components, have given tremendous impetus to the search for quick and accurate devices that can give answers speedily.

Except for the electronic methods to be described, most of the "new" plant control means that have come from this search are actually not new at all to the research physicist and research chemist. Several of the methods have had a long and honorable history in the study of atomic and crystal structure. What is new in these cases is a more general realization that the same devices can yield information on composition, as well as on structure, and do it usually much faster than can be accomplished chemically. Also new is the fact that the instruments have now been developed from an engineering standpoint and their frequent temperamental characters considerably modified. This has come about following the realization that these devices are no longer in the sole province of a few fundamental researchers, but are moving into industrial work of several kinds, particularly industrial control.

It should not be concluded that these devices can yet be classed as industrial instruments, although some are certainly moving in that direction. In the main they are expensive, running into the thousands rather than hundreds, of dollars. They cannot yet be turned over to the plant instrument department in most cases, for installation and servicing, and they cannot operate for weeks at a time without other attention than they would receive from a plant operator. Most such instruments at present are under the control of men of long training in research and such men are usually necessary for their supervision and for the interpretation of results. However, in many cases the actual operation is being turned over with excellent results to technicians of high school grade, since not a great deal of training is needed if the supervision is competent. And as further development takes place and still better understanding of the best sort of use for each type is achieved, some will inevitably become completely automatic in operation and some will be further adapted to automatic control. Several, in fact, can already record their results automatically and some are at present suitable for continuous-flow samples. At least one of these instruments

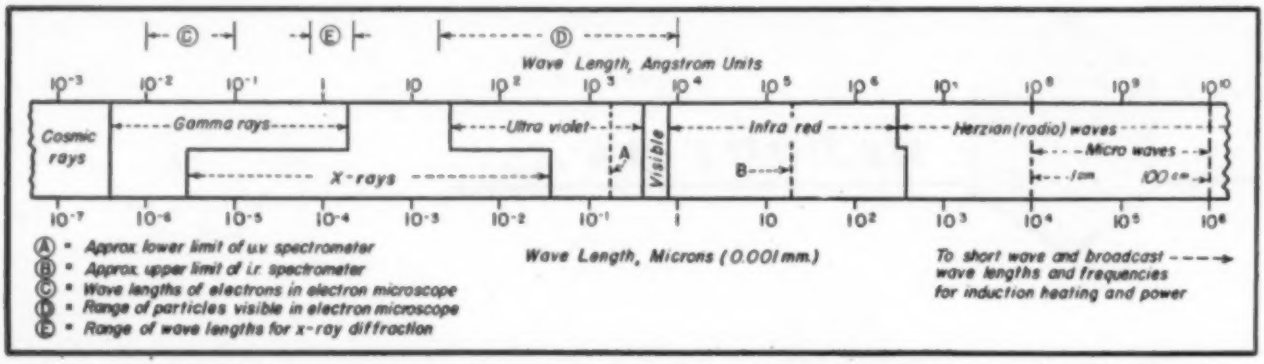

Wave Length, Angstrom Units
Cosmic rays
Gamma rays
X-rays
Ultra violet
Visible
Infra red
Herzian (radio) waves
Micro waves
Wave Length, Microns (0.001 mm.)
To short wave and broadcast wave lengths and frequencies for induction heating and power
Ⓐ = Approx. lower limit of u.v. spectrometer
Ⓑ = Approx. upper limit of i.r. spectrometer
Ⓒ = Wave lengths of electrons in electron microscope
Ⓓ = Range of particles visible in electron microscope
Ⓔ = Range of wave lengths for x-ray diffraction

Fig. 1—Portion of electromagnetic spectrum showing ranges involved in instruments covered in this discussion

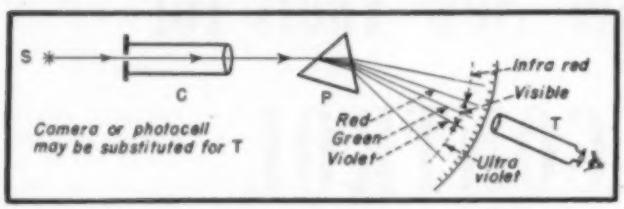


Fig. 2—Diagram of simple spectroscope and spectrum

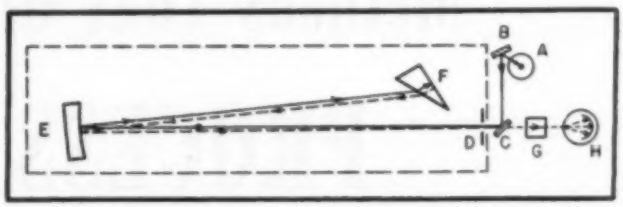


Fig. 3—Hook-up of quartz spectrophotometer

is being used for automatic control and others are doubtless only awaiting suitable applications.

NEW TOOLS

Materials have only a comparatively few properties that can be measured for the determination of composition, and most of these have been mentioned in an earlier paragraph. Simple mixtures and solutions of a single solute generally yield to measurement of a single property, provided one can be found which is sufficiently characteristic. More complex mixtures sometimes yield to the simultaneous measurement of two properties. There is a class of properties, however, that give highly characteristic reactions in the majority of cases, enabling at least one and sometimes several different methods to be used to identify the constituents of a mixture, both qualitatively and quantitatively, even in extremely complex cases. This class includes a number of methods involving radiation, either the radiation given off by the material itself under suitable excitation conditions; or, more commonly, some characteristic effect produced on the material itself, or on the radiation, when the material is subjected to radiant energy of suitable wave length. Greatly simplified, a portion of the electromagnetic spectrum which is of interest in a discussion of these instruments is presented in Fig. 1. Although radiations of various wave lengths are frequently described in terms of their frequency, it will be more convenient here to employ wave length units. Since several different units are customarily employed in the literature, and can easily result in confusion, the tabulation below is given to facilitate interchange among systems of units.

mm.	1	10^{-3}	10^{-6}	10^{-7}
μ	10^{3}	1	10^{-3}	10^{-4}
mμ	10^{6}	10^{3}	1	10^{-1}
A.U.	10^{7}	10^{4}	10	1

Frequency corresponding to these wave lengths is, from left to right, 1/3 (10^{11}, 10^{14}, 10^{17}, 10^{18}).

The present article uses the micron μ as the most convenient unit of measure, although the millimicron and the Angstrom unit are also used to a large extent.

Of the instruments employing radiation given off by the material to be identified, there are several which collectively encompass the field of emission spectroscopy. These are used extensively in metallurgy for the identification of metallic elements, but are generally of less interest in the chemical field. Instruments employing radiation from a separate source to act on the material being identified include several types making use of different effects: (1) Absorption of radiation of certain characteristic wave lengths; (2) diffraction or scattering of X-radiation or an electron beam at angles dependent on the structure of the material; (3) ionization of gaseous molecules by electron impact, followed by sorting of the ions and ionized fragments according to mass, and measurement of the quantities of each; (4) using a beam of electrons instead of light in a system of electrical "lenses" to produce a magnified image of minute objects, similar to that of a light microscope, but at magnifications up to 100 times as great; and finally (5) a method not much used industrially at present, but seemingly capable of considerable expansion, namely, measurement of index of refraction of the material at some suitable wave length of light.*

SPECTROGRAPHS

Most of the devices discussed here employ some sort of spectroscope or spectrograph, since it is necessary to identify and measure the spectrum produced, transmitted or reflected by the substance under examination. Furthermore, when the intensity of any part of the spectrum is to be measured, some form of photometer is required (except when the spectrum is recorded photographically). Although the principles of spectroscopes and photometers are elementary in physics, it may be well to review them briefly before going on to the instruments themselves.

In Fig. 2 the formation of the spectrum of radiation passing through a slit and falling on the glass prism of a spectroscope is indicated. It will be observed that the refraction† is less at the lower frequencies (greater wave lengths) and that the infra red appears at the upper end of the spectrum, followed by the visible spectrum, from red through violet, and then the ultra violet.

There is another method of dispersing a spectrum, employing a device known as a concave diffraction grating. This consists of a highly reflecting concave mirror having its center of curvature at the slit through which the radiation is introduced. Parallel to the slit on the reflecting surface are a large number of non-reflecting lines with distances of the order of 0.0001 to 0.00005 in. between the lines. The theory behind the device is considerably more involved than that of the prism, but suffice it to say that interference effects between the waves reflected from the numerous reflecting surfaces will disperse the reflected light and produce a series of identical spectra either side of the center line.

* Such an instrument has been designed by Shell Development Co., especially for the continuous analysis of butadiene. It is manufactured and sold by Precision Scientific Co.

† When a ray from a luminous source such as a lamp filament passes from one medium such as air into another medium such as glass, which has a different index of refraction, the ray will be bent at the surface separating the two media, provided the initial ray is not normal to the surface. In glass the velocity of the ray will be less than in air (described as an index of refraction greater than 1.0) and the ray will be bent *toward* the normal. When the ray again emerges into the air it will be bent again, this time away from the normal. If the faces of the glass are not parallel, the emergent ray will have been dispersed into a spectrum comprising all the frequencies in the entering ray, since the amount of bending or refraction depends on the velocity, which varies for different frequencies. In practice, the refracting medium is usually a prism—often glass. The material is chosen according to its transparency to the desired frequencies of radiation. Glass, for example, is transparent throughout the visible range and for a short distance into both the infra red and ultra violet. For ultra violet transmission, quartz or fluorite are used, and for infra red, rock salt.

A spectroscope, then, consists as in Fig. 2, of a device C known as a collimator, consisting of a narrow slit and the necessary lens, for introducing the radiation from source S; a prism P or grating for dispersing the radiation; and a means T for viewing the resulting spectrum. In a spectroscope this last is a telescope mounted on a quadrant which permits viewing any part of the spectrum and determining the angle of its refraction. In a spectrograph, a camera capable photographing the entire spectrum simultaneously is substituted for the telescope. Photographic plates can be made sensitive to radiation over a considerably greater range than the human eye, covering the interval from about 0.15 μ in the ultra violet to about 1.2 μ in the infra red. The placement of the film or plate is such that the angle of refraction of each line or area can be determined. When the radiation is light, or not far from light in its frequency, and means are provided for measuring both angles and intensities, without photography, the term used is spectrophotometer.

When any material is heated sufficiently, excitation of its electrons causes it to radiate at a number of frequencies, which are characteristic of the elements composing the material. The spectrum of each element is generally radiated independent of the others present. In the case of incandescent gases, the spectrum shows a series of bright lines, each an image of the slit, separated by dark spaces. Their spacing indicates the radiated frequencies. An incandescent solid or liquid, however, radiates a continuous spectrum in an unbroken series of colors. Since each element gives a characteristic spectrum, it is possible to identify the elements in a radiating source by comparing the spectrogram with those of known elements or with data recording the location of their lines. This is the basis for emission spectroscopy.

When radiation of various wave lengths is passed through a transparent substance, some frequencies are transmitted and others absorbed, and just as in the case of emission, the absorption pattern is characteristic of the substance. In fact, a gas absorbs the same frequencies that it would emit if heated to incandescence. In addition, certain characteristics of the structure of the substance, such as double bonds, can be identified by the absorption pattern. Isomers can readily be distinguished by reason of different characteristics of their absorption. The property of absorption, then, is the basis of absorption spectroscopy and so far as principle is concerned is the same whether the characteristic absorption is found in the infra red, visible or ultra violet ranges of frequency. All that is necessary to identify materials by their absorption patterns is to provide radiation in a suitable range of frequencies** which is then passed through the substance and the absorption at each frequency measured. By comparison of the transmitted spectrum with the absorption spectra of known substances, the sample may be analyzed both quantitatively and qualitatively.

This description has oversimplified the problems of spectrometry. Simple in their fundamental application, if not in the mechanism of emission and absorption, spectroscopic devices tend to be complex in operation. Therefore, they require highly developed instrumentation and a nicety of manipulation.

PHOTOMETERS

In interpreting the results of spectroscopic analysis, the frequencies at which radiation is emitted or absorbed give information of qualitative character only. For quantitative measurements, ability to judge or measure the intensity of emission, or the proportion of the total incident radiation of any frequency which was absorbed, is essential. Devices for measuring the intensity of radiation in or near the visible range are called photometers. In spectroscopes using visual estimation of intensity the optical system provides a split field of vision, half of which is illuminated with a part of the radiation currently being used, and half with the remainder of this radiation after absorption by the sample. A shutter, flicker disk, or comparable arrangement such as crossed polarizing prisms enables the intensity of the direct radiation to be decreased until a photometric match is obtained with the portion that has been partially absorbed, thus giving a measure of the absorption. In instruments using electrical determination of intensity, the detector for the visible and ultra violet range is a photocell of suitable characteristics, and in the infra red range, a thermopile or bolometer.

The term photometer is also applied to light measuring devices adapted to measure the intensity of one or only a comparatively few rather broad bands of frequencies in the visible range. Such instruments generally employ either daylight or radiation from an incandescent filament and produce a band of roughly monochromatic light by means of colored filters which stop the unwanted frequencies. They are used for color matching, colorimetric analysis and, without filters, for turbidity, reflection, opacity and gloss measurements.

Spectroscopic instruments which record a spectrum photographically require still a different device for measuring the intensities of the recorded lines. The most usual means for doing this is to employ what is generally called a densitometer, a photoelectric instrument capable of projecting an extremely narrow beam of light through each line of the plate or film in turn, which is then measured by a photocell. In the more highly developed types the plate is supported in a power driven carriage and moved slowly between the light source and the photocell. The position of each line (corresponding to its frequency) is then plotted continuously by a strip chart recorder against the intensity of that line so that the record permits quantitative analysis.

EMISSION SPECTOGRAPHY

Used mainly for metallurgical identification and analysis, emission spectrography[2e, 2f, 4] employs either a spark, an arc or a flame for exciting the material to be examined and causing it to emit its characteristic spectrum. The spectrum produced is independent of the excitation (or temperature) except that higher excitation produces a greater number of characteristic lines. The arc spectrum, most widely used, is produced by placing a quantity of the sample in a depression in the lower carbon electrode (anode) and drawing a 2,000 volt a.c. or half-wave d.c. arc. Specially purified carbon is employed for this purpose. In some cases, metallic specimens may be cast or machined into anodes and thus used directly. In spark spectroscopy, a high frequency spark is employed, rather than an arc, giving greater excitation and consequently requiring a shorter exposure. The spark also is superior in bringing out the lines for certain nonmetals and hence can be used in organic analyses.

Spectroscopes employed in emission spectrography are entirely similar to those described in earlier paragraphs, employing either a prism or a grating for dispersion. Since spectra of many elements lie in both the ultra violet and visible ranges of frequency, the optical system is usually of quartz. Recording is by photographic plate or film and the usual arrangement is to photograph a considerable number of spectrum bands on a single plate. Emission spectrography is comparatively rapid. For example, Moran[2e] states that one man can run at least 20 analyses on rayon grade caustic, analyzing for seven elements, in an eight-hour day. By chemical analysis, the job would consume several man-days. Furthermore, the method often effects identifications difficult by chemical means and readily permits the finding of trace elements and their quantitative estimation.

Flame emission is of little interest except in certain specialized applications. An instrument developed in the Physics Department of American Cyanamid Co., (now built commercially by Perkin-Elmer Corp.), is known as the Flame Photometer and is of interest for the rapid routine determination of sodium and potassium salts in solution in the presence of other elements. Difficult by chemical methods, this analysis can be accomplished in 2 minutes for 3 percent accuracy, or in 20 minutes for 1 percent accuracy. The sample is aspirated from a beaker and sprayed into a gas flame. A strong characteristic frequency for each of sodium and potassium is isolated by means of two appropriate color filters and applied to two photocells, one for sodium, the other for potassium. A switch enables either cell to indicate on the meter.

ABSORPTION SPECTOGRAPHY

As previously mentioned, transparent substances such as liquids and gases absorb certain frequencies of radiation in a characteristic manner and, with a few exceptions, the percentage absorbed is directly proportional to the number of molecules

** In determining the absorption is is possible either to pass radiation of all wave lengths supplied by the source simultaneously through the sample, after which the transmitted radiation is analyzed by means of a spectrophotometer; or alternately, the radiation may first be separated into approximately monochromatic frequencies by means of a spectroscope (monochromator), after which each frequency in succession is passed through the sample and the extent of its absorption measured. In practice, the latter method is generally used.

of the absorbing substance in the line of sight. Colored substances absorb in the visible range and colorless ones in the ultra violet or infra red ranges. Which range will give a characteristic pattern depends on the substances present.

Ultra Violet—Absorption spectrography in the ultra violet range[1, 2, 8c] has less application than in the visible and infra red ranges, but it is neverthless of considerable interest in the field of aromatic and unsaturated aliphatic compounds, which have absorption bands in the ultra violet. Benzene absorbs strongly at several ultra violet frequencies, as do toluene, the xylenes, and conjugated diolefins such as butadiene. Such saturated hydrocarbons as propane and butane do not absorb in this region, nor do simple unsaturates such as the butylenes[3]. These require infra red radiation for characteristic absorption.

Other applications for the ultra violet spectrophotometer have been made in vitamin A determinations (after removing interfering substances), chromates (said to be superior to visible light analysis), sulfanilamide and derivatives, and drying oils and fatty acids.

Instruments for the ultra violet region are generally referred to as quartz spectrophotometers, since their transmitting portions in the optical system are of either fused or crystal quartz. The one produced by National Technical Laboratories[4] is available in an automatic recording model which has recently been described by Beckman[3]. With the proper light source, the instrument can be used between 10 μ in the near infra red, through the visible range, to 0.2 μ in the ultra violet. For ultra violet absorption, a hydrogen discharge lamp provided with electronic voltage control supplies the radiation. The radiation from *A* in Fig. 3 is projected by a condensing mirror *B* and a diagonal mirror *C* through an entrance slit *D* on to the collimating mirror *E*, which renders the light parallel and reflects it on to the crystal quartz prism *F*. Since the back of this prism is aluminized, the light is reflected back through the prism, undergoing further refraction. The spectrum so produced is reflected by the collimating mirror and focused on the exit slit which is above the entrance slit at *D*. By rotating the prism, light of any wave length within the range of the instrument can be projected through the exit slit where it passes through the absorption cell *G*, which contains the sample, to a photocell *H*. The cell output is amplified electronically and recorded on a Brown recorder.

For continuous automatic operation, the instrument receives a continuous flow sample and is operated at some single wave length which is characteristic of the sample, for example, 0.23 μ for butadiene. The instrument has been applied to automatic control of reflux ratio in some butadiene installations[1].

Visible Range—Use of radiation in the visible range[10, 9] does not differ fundamentally from that in the ultra violet and infra red ranges except for the fact that, being perceptible to the human eye, it involves color and becomes of interest for colorimetric purposes, as well as for the determination of composition. In fact, colorimetry, rather than analysis, is usually the purpose in this range. It permits direct visual comparisons, which the other ranges do not, although the trend in modern instruments is largely in the direction of eliminating the human variable by use of photocells. The radiation range employed in this case is from 0.4 to about 0.77 μ.

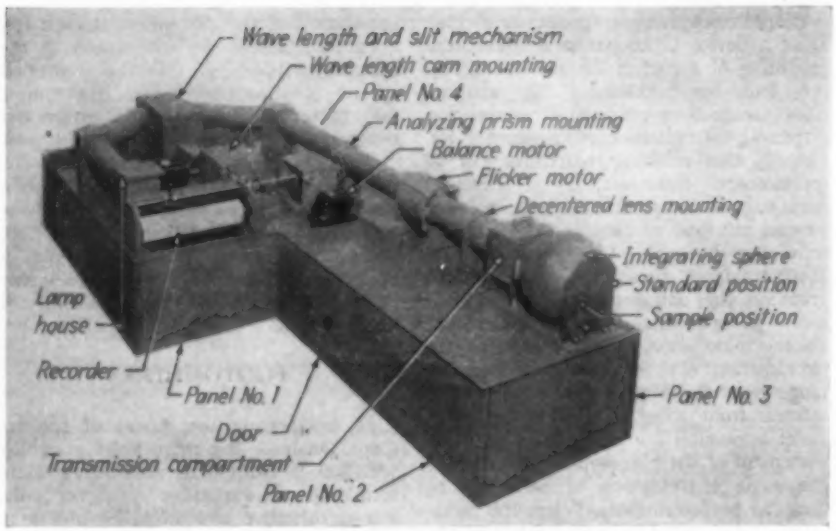


Fig. 4—General Electric (Hardy) recording spectrophotometer

Instruments of this class are of two general types, spectrophotometers which disperse the light with a prism or grating, so as to be capable of handling the entire range; and those using filters to isolate certain desired portions of the spectrum, which are called filter photometers and colorimeters. With instruments of the latter class, the isolation of wave lengths is considerably less perfect than with spectrophotometers, giving color bands 0.025 to 0.1 μ wide as compared with the nearly monochromatic bands 0.001 to 0.01 μ wide for instruments of the first type[2b].

Visible range spectrophotometers are of numerous types. Their fundamentals are identical with those of other spectrophotometers, although in some cases the instrument designs differ rather markedly. Perhaps the best known and certainly the most spectacular of these instruments is the Hardy recording spectrophotometer[8] made by General Electric Co. This device (Fig. 4) is able to record a complete color analysis curve of the light transmitted or reflected by a substance in 2½ to 5 minutes. Light from an incandescent lamp is passed through a series of prisms, slits and lenses to collimate it and to isolate the desired wave length, which is then flickered alternately, at 60 times per second, onto the sample and a standard.

The flicker system is extremely ingenious, using a combination of stationary and rotating polarizing prisms to direct the monochromatic light first on the standard and then on or through the sample, whichever is desired. The transmitted or reflected light is then directed on to a single photocell by means of an integrating sphere, in which are provisions to either retain or eliminate the gloss component. If the light from both sample and standard are the same, the cell illumination is constant and the system is in balance. If they differ on account of unequal absorption of a particular wave length, the pulsating output of the cell is applied to a small split phase d.c. motor after thyratron amplification. This motor acts to cut down the light reaching the standard by rotating one of the fixed polarizing prisms so as to reduce the transmission during the time light is reaching the standard. But, since the prism's position is a measure of the degree of absorption, the same movement is transmitted to the recorder pen. Meanwhile the monochromator, which provides the illuminating beam, is constantly changed by a "wave length motor" and this motor turns the recorder chart so as to plot wave length against transmission.

Most instruments for photometric comparisons in the visble range are relatively simple and inexpensive. One type of filter photometer, the Photelometer of Central Scientific Co., for example, is used extensively in the colorimetric analysis of metals and consists of a small light source, a shutter for controlling the amount of light used, a lens for concentrating the light beam, a cell for holding the solution under test, a photoelectric cell for measuring the light passing through the sample and a galvanometer for indicating the photocell current. A filter of desired color is used since a photocell does not distinguish between colors. For this purpose, three color filters are mounted in a slide so that any one may be used. A somewhat similar instrument, the Electrophotometer of Fisher Scientific Co., also provides three filters but in addition permits the selection of four specific levels of illumination. In this case the cell output is determined by means of a potentiometer, permitting a relatively long scale reading. With these instruments, a single beam of light is used both as the measuring and the reference beam. Before making a measurement it is necessary to adjust the illumination to 100 percent transmittancy against a standard which is then replaced by the unknown. In still another type, the standard and sample are illuminated simultaneously, transmitting on to two photocells in a

Wheatstone bridge circuit. Frequently filter photometers are developed for special purposes. For example, Hercules Powder Co. has developed a simple photoelectric instrument of this type for the rapid and accurate grading of rosin. Through its use, it is possible to disinguish eight sub-grades, approximately, between the grades which can be separated visually by expert graders.

Williams[9] has indicated several important classes of use for visible spectrophotometers, including identification of dyes, analysis of mixtures; study of equilibriums such as in pH determination with indicators; and the determination of structure of synthetic organic compounds. The more complex instruments such as the Hardy permit a complete color analysis to be made with the result that two samples having the same analysis will inevitably reflect identical colors under all conditions of illumination.

Infra Red Spectroscopy—Although more difficult technically than visible or ultra violet spectroscopy, spectroscopy in the infra red region opens up possibilities for analysis of colorless compounds that are much more extensive than those for which ultra violet can be used. One difficulty is that the intensity of illumination available varies widely with the wavelength. Most instruments for infra red work employ a rock salt prism, although other materials such as potassium bromide, calcium fluoride and lithium fluoride may be used under certain conditions.

One of the best known instruments of this character, of which several hundred are in use, is the infra red spectrophotometer produced by National Technical Laboratories. This instrument is being used extensively for hydrocarbon analysis in aviation gasoline and butadiene plants, providing a rapid and accurate method of analyzing hydrocarbons, particularly C_4, saturated hydrocarbons and mono-olefins. Butane and isobutane, the butenes and isobutene are typical examples.

The optical system of this instrument is somewhat similar to that of the ultra violet spectrophotometer, except that the absorption sample precedes, rather than follows, the monochromator. In the latest type produced by this company, diagrammed in Fig. 5, illumination produced by the Nerst glower *A* is focused on the sample cell by a concave mirror *B* after passing through a revolving shutter *C* (which, as later described, is involved in the amplification system). Passing through the entrance slit *D* and the rock salt lens *E*, the radiation then traverses the liquid sample cell *F*, a filter slide *G* carrying MgO and LiF filters and enters the cell *I*, used for gas samples, which is sealed at either end with rock salt lenses *H* and *J* used to focus the radiation on the entrance (upper) slit *L* of the monochromator. Here the beam travels from the collimating mirror *M* through the rock salt prism *N* to a rotatable Littrow mirror *O* that reflects the beam back through the prism, to *M*, and thence to the exit slit *L* beneath the entrance slit. By proper setting of the mirror *O*, radiation of any selected wave length passes through the exit slit where it is directed by mirrors *K* and *P* on to the bolometer at *Q*. A phototube at *R* is provided to monitor the output of *A*.

The reason for the shutter *C* now becomes apparent. Since the radiation is interrupted ten times per second, the output of the bolometer is also similarly interrupted, permitting amplification by a special electronic circuit tuned to this frequency. The amplifier output is connected directly to a conventional chart recorder. With the same motor driving both the wave length setting at *O* and the recorder chart, the record of intensities of illumination transmitted is automatically correlated with wave length.

As an example of how an infra red spectrogram appears, Fig. 6 (after Beckman) shows the absorption curves for mixtures of *n*-butane and isobutane. The topmost curve contains 99.4 percent *n*-butane, the second curve 30 percent isobutane, the third curve 70 percent isobutane and the bottom curve 99.7 percent isobutane. Only a comparatively few peaks are shown here. A complete absorption curve is often very complex.

Micro-Wave Analyzer—An instrument which is now in the experimental stage at the RCA Laboratories, developed by Dr. W. D. Hershberger, appears to bear some similarity in principle to the instruments already described. It employs absorption of radiation as a means toward identifying gases, but the radiation used is in the wave length range from 1 to 100 cm. (10^4 to 10^6 μ), which is in the region of short Herzian waves, slightly shorter than those used for experimental shortwave transmission. The instrument may prove useful in the future in indentifying a considerable number of gases.

DIFFRACTION ANALYSIS

X-Ray Diffraction—Diffraction patterns produced by both X-ray bombardment and by electrons can be used for the identification of the components of a sample. At present, the first type of radiation is used considerably more extensively although the latter has the advantage of being able to determine surface conditions more accurately than the former. Like emission spectrography, diffraction methods produce patterns of lines which are characteristic of the arrangement of the atoms in the material being examined. The mechanism differs considerably, however.[10] Although an explanation of the formation of diffraction patterns is too complex for this discussion, it can be pointed out that the radiation is reflected at glancing angles from various scattering points which form planes in the crystal lattice. The relative intensities of the maxima produced are dependent on the number of atomic planes irradiated, hence on the absorption of radiation in the material. Thus the combination of intensity and angle of refraction supplies information characteristic of the crystal's structure and of the atoms of which it is composed. Electron diffraction[7] is similar to X-ray diffraction in this respect, except that with the latter, the penetration into the sample is much less pronounced.

In X-ray diffraction, the sample may be either a single crystal, a solid surface, a fibrous amorphous or a powdered crystalline substance. Ordinarily the diffraction spectrum is produced on a photographic film and there are various techniques and various forms of camera used that produce different sorts of patterns which cannot be gone into in detail here. Suffice it to say that in the so-called powder camera a beam of substantially monochromatic X-radiation (obtained by electron bombardment of a target of such metals as molybdenum, copper, cobalt, iron or chromium and passed through suitable filters) is collimated through a number of pin holes. (X-rays cannot be collimated with lenses.) The beam then irradiates the sample, which is often a small rod of the specimen material, held together with a binder and placed on a rotating

Fig. 5, Below—Hook-up of Beckman infra red spectrophotometer

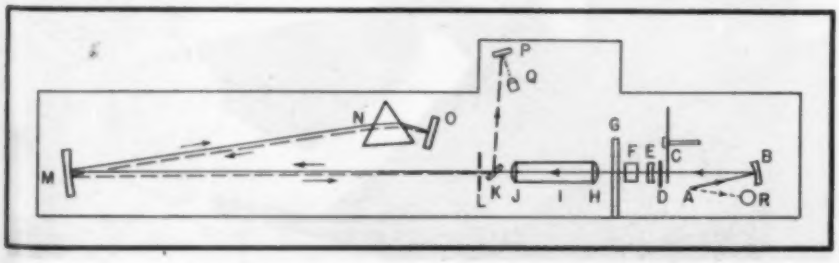
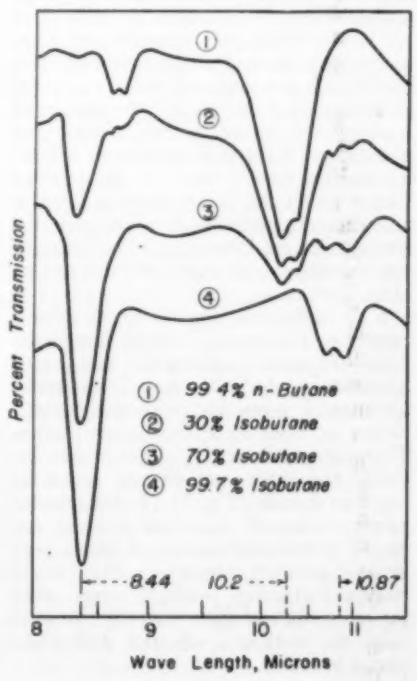


Fig. 6, Right—Absorption curves for mixtures of butane and isobutane



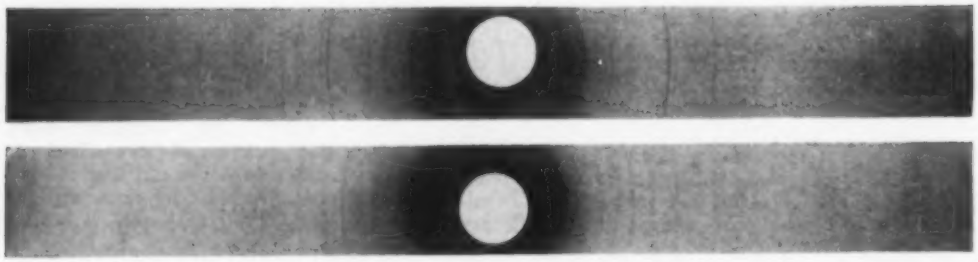


Fig. 7—X-ray diffraction powder patterns, showing readily distinguished differences between rutile and anatase phases of titanium dioxide; rutile above, anatase below (Photos from Picker X-Ray Corp.)

spindle at the center of a cylindrical drum. The film is wrapped around the inner surface of the drum. The pattern consists of a series of radial arcs, as in Fig. 7, ranging from a small radius around the collimator tube (and at a point 180 deg. away), to straight lines at points 90 deg. from the collimator. In the Laue camera a flat photographic plate is employed on which diffracted rays are projected from the sample, the latter being held centrally between the film holder and a pin hole that emits X-rays. The instrument which appears to have the greatest possibilities for industrial control work is the Geiger-Counter X-ray spectrometer, which was developed at the Naval Research Laboratory and engineered and produced by North American Phillips Co.[8] This instrument, as shown in Fig. 8, employs a horizontal air-cooled X-ray tube, giving radiation which is filtered to make it substantially monochromatic, between 0.709 and 2.28 Angstrom units wave length. The radiation is collimated through a series of slits after which it falls on a powder sample held by a binder on a microscope slide. A Geiger counter tube arranged to move around a 90 deg. quadrant is used to determine the intensity of radiation diffracted at various angles. This tube consists of a cylindrical conducting envelope evacuated and refilled with a low pressure of a suitable gas such as argon, containing at its center a continuous wire electrode insulated from the outer envelope. With the wire grounded and the outer envelope maintained at a substantial potential such as 1,200 volts, the entrance of X-ray quanta into the end of the tube (which is closed with a transparent window) results in ionization of the gas and the passage of a measurable current. In this fashion, each quantum of X-radiation produces a definite momentary current flow in the external circuit which can be amplified and fed to an indicating meter or to a recorder, the latter indicating intensities of radiation by pen movement and angles of diffraction by chart movement.

X-ray diffraction appears to be coming rapidly to the fore as a means for identifying crystalline substances. Since each substance produces its own characteristic spectrum, it is possible as in other spectrometric methods to analyze quantitatively. The instrument readily differentiates between the rutile and anatase phases of titanium dioxide (Fig. 7). It distinguishes various forms of silica and is being employed in the manufacture of phosphorus, ceramic products, pigments, certain fibers, powder metallurgy products, soaps, welding rod fluxes and other materials. In some cases the method is effective with amorphous materials.

As indicated, electron diffraction has been used to a lesser extent. Because the electrons employed are of considerably shorter wave length, for example in the neighborhood of 0.053 Angstrom units (0.0000053 μ), the angle of scattering is less than that with X-ray diffraction and the intensities of the diffracted patterns are much greater than those obtained with X-rays, permitting much shorter exposures. The method has been used in the study of thin films of inorganic and organic materials, oxides and other corrosion films, polished surfaces, crystal growth, electrodeposited metals, surface catalysts, colloids and surface impurities. Because the instrument itself is closely allied to the electron microscope, later to be described, the equipment for electron diffraction will be described in that connection.

MASS SPECTROMETER

One more principal scientific tool for analysis of materials remains to be described. The mass spectrometer[9a,7,11,12], shown in Figs. 9 and 10, is a device which, in essence, ionizes the unknown sample of gas or vapor, then sorts the ions according to their mass (molecular weight) and determines the relative numbers of ions of each mass. How this is accomplished is best shown in connection with Fig. 9 which shows schematically a typical mass spectrometer tube of the 90 deg. turn type. Two types of tubes are used, the 90 degree, produced by Westinghouse Electric Corp., and the 180 deg., produced by Consolidated Engineering Corp. Operation of the two types is similar, the differences being beyond the scope of this discussion. A low pressure of the gas to be analyzed (about 0.001 mm. Hg) is admitted into the ionization chamber at the upper end of the tube where the molecules of the gas are bombarded with a fast moving stream of electrons which move from the filament toward the right. The electrons are given their energy electrostatically by applying a potential between electrodes at the opposite sides of the ionization chamber. The energy of the electron stream is such that many of the gas molecules are split into charged fragments while those which are not split are likewise charged by ionization. It might appear that the splitting into fragments would produce an indecipherable conglomerate of particles but this is incorrect since each different molecule yields its own characteristic distribution of fragments of various masses, a fact which enables isomers and other molecules of equal molecular weight to be distinguished. Once the ions are formed, it is necessary to find some method of distinguishing between them. This is accomplished by giving the ions an acceleration into the analyzer tube, using an electrostatic field produced by a second set of electrodes normal to the first. Within the tube the path of the ions is bent by means of a magnetic field established by pole pieces either side of the tube. For an ion of any given mass, a relation exists between the accelerating electrostatic field and the

Fig. 8—Geiger-Counter X-ray spectrometer of North American Philips Co.

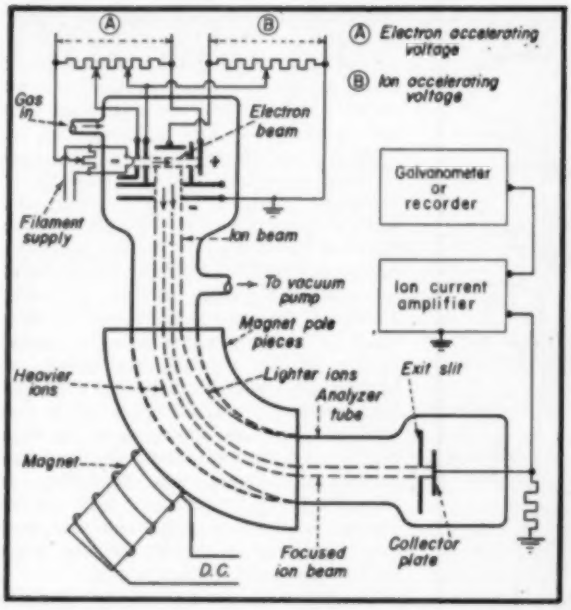


Fig. 9, Above—Simplified diagram of Westinghouse type of mass spectrometer, with main circuits

Fig. 10, Right—Westinghouse mass spectrometer

magnetic field, which will cause the radius of curvature of the ion in the magnetic field to equal that of the tube, thus focusing that particular ion and others of the same mass upon the exit slit. These ions pass through the slit and bombard the collector plate, causing flow of a measurable current which can be amplified and suitably recorded. In practice, focusing for each successive mass from the lowest to the highest for which the instrument is suitable is accomplished by continuous variation of the ion accelerating field.

Since the current carried by each ion is equal to that carried by any other ion, regardless of mass, the current produced at the collector plate is proportional to the number of ions of the mass being focused on the exit slit at any instant. Thus a record of the mass spectrum of any sample can be made by plotting the instantaneous values of the ion current (which are proportional to concentration) against the instantaneous values of the electrostatic field, which are proportional to the mass being focused on the slit. Three methods of measurement are currently being employed. In one method, the amplified ion current operates four mirror galvanometers of different sensitivities which record simultaneously on a sensitized chart; in another an ordinary indicating mirror galvanometer is used; in the last a mechanical strip chart recorder is employed after further amplification. The record of a mass spectrometer appears as a succession of sharply defined peaks corresponding to the various multiples of the fundamental hydrogen mass. The pattern so produced is characteristic of the substance and the pattern produced by a mixture is characteristic of the superposition of the components. Therefore, knowing the positions and intensities of the masses for pure substances, it is possible mathematically to separate the patterns, both quantitatively and qualitatively.

It is at present, unfortunately, a peculiarity of several spectrometric methods, including the mass spectrometer, that the time needed to calculate a result is generally considerably more than that required to run a sample. In a typical case with the mass spectrometer, the instrument time will be 15 to 20 minutes per sample, but the calculation of results may require from one-half to several hours, depending on the number of components to be determined, the complexity of the mixture and the amount of interference of one compound with another[9,11,12]. Since the calculation involves the solution of a considerable number of simultaneous equations in most cases, the new electrical computer for simultaneous equations, recently introduced by Engineering Laboratories, Inc., of Tulsa, should materially speed the computation of mass spectrometer results (as well as those of the infra red spectrophotometer). It is claimed that routine problems involving 11 simultaneous equations in 11 unknowns can be solved in 5 min.

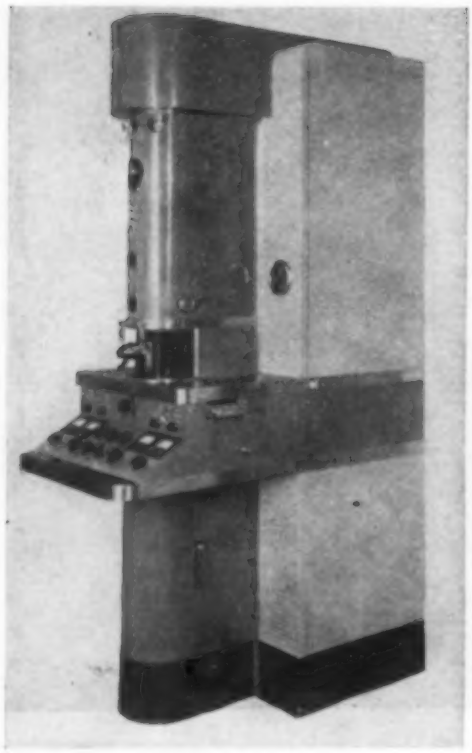
The number of mass spectrometers currently in industrial use is not known but probably totals less than two dozen. The instrument has been used to date largely for analyses in the hydrocarbon field, to C_8 compounds, but it can be employed with any material that can be introduced in a gaseous or vapor state at a pressure in the neighborhood of 1 micron (0.001 mm. Hg) at room temperature. The principal exceptions seem to be materials such as water and alcohol which are strongly adsorbed on the glass surfaces of the sample handling equipment.

ELECTRON MICROSCOPE

Perhaps 100 electron microscopes (Figs. 11 and 12) are currently operating in industrial laboratories in the United States today, many more than in all other countries combined. The device is being used for a wide variety of purposes ranging from fundamental research to industrial control in the field of pigments, dyes, films, fibers and other chemicals. The only instrument currently on the market is that manufactured by the RCA-Victor Division of Radio Corp. of America, although the General Electric Co. developed an instrument of different type some years ago. The RCA design, based on developments of Dr. James Hillier and his associates, employs electromagnetic focusing of the electron beam, whereas the General Electric and some European types used electrostatic focusing. Apparently the former type has been more successful.

The electron microscope, since its first industrial use in the United States in December 1940, (in the Stamford laboratory of American Cyanamid Co.), has been described in a great many publications and its description will not be detailed here. Theoretically, since the wave length of the electrons used is approximately 1/100,000th that of visible light (See Fig. 1), it should be possible to produce magnified images of objects placed in the path of the electron beam with a magnification 100,000 times that of the light microscope. For many reasons, however, the actual resolving power according to Hillier[6] is of the order of 50 to 100 times that of the light microscope. The possibilities for increasing this factor materially are not great but nevertheless electron microscopes are now capable of magnifying about 100,000X.

Where the light microscope uses glass lenses and visible radiation for the magnification of objects, the electron microscope employs magnetic "lenses" and a beam of electrons which is first concentrated on the object and then spread for projection on a fluorescent screen or photographic plate, as in Fig. 12. It is necessary to operate at a relatively low pressure in the instrument, in the order of 0.1 to 0.01 microns



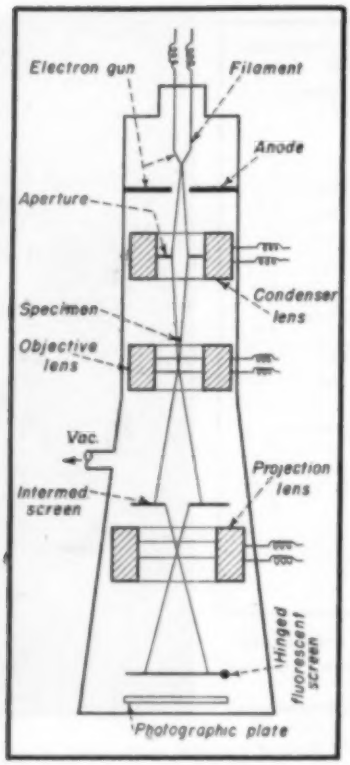


Fig. 11, Left—Latest type of RCA electron microscope (Universal model)

Fig. 12, Right—Diagrammatic arrangement of "lenses" in microscope

(0.001 mm. Hg). The electron beam, produced by a heated filament, is accelerated by an anode and then condensed by the first magnetic lens. It is then projected on the specimen which causes some scattering and absorption. The transmitted rays enter a magnetic lens which focuses them into a first image of the specimen. This image is further magnified by still another magnetic lens and projected on a fluorescent screen to permit focusing and visual observation. The magnetic lenses have no characteristic focal length but can be varied at will by varying the current through the exciting coil by means of a variable resistor. Thus, varying the focus and magnification is accomplished with the greatest of ease. Once the desired image has been produced on the fluorescent screen, the screen itself (in the latest instrument, Fig. 11) is hinged out of the way and exposes the photographic film.

Although the electron microscope does not, of course, identify the elements composing the objects magnified, it does nevertheless facilitate various forms of plant control since shape and appearance of particles are often correlated directly with some desired quality. For example, in the pigment field, it has been possible to correlate shape and particle size distribution on the one hand, and performance and covering power on the other. The instrument has proved extremely useful in correlating the properties of carbon black with performance, and in controlling the continued production of blacks of desired properties. As a means of extremely accurate particle size determination, it has proved useful in other fields such as the making of chemicals and metal powders.

It was mentioned in a preceding section that the electron diffraction camera was closely related to the electron microscope and hence would be described with the latter instrument. Although diffraction cameras have been built without the microscope feature, ability to take diffraction photographs is incorporated in all of the larger of the two types of electron microscopes now produced by RCA.[6] This is readily accomplished by adding a device for holding and manipulating the sample so that it can be either bombarded or grazed by a collimated beam of electrons from the electron gun at the top of the instrument.

Another characteristic of the electron beam has been pointed out by Hillier[8] and has been investigated by this worker and his collaborators, although the instrument employing this characteristic is not on the market. The electron microanalyzer is a device, also used in conjunction with the electron microscope, permitting the formation of a spectrum similar to a spectrum in the near-visible range which, like the latter, is characteristic of the atoms composing the material. In this case it is not necessary for the material to be crystalline in nature. Very briefly, the microanalyzer technique focuses a very concentrated and minute beam of electron energy on some extremely minute selected area of the electron microscope image which it is desired to examine. Thus, the method can be used for investigating the composition of individual particles and on that account probably will not have eventual plant control implications since analyses for the latter purpose are concerned with averages of large quantities, not composition of individual particles. In any event, the method operates on the principle that the electrons transmitted by the specimen lose energy as a result of inelastic collision with the atomic electrons in the specimen. Therefore, the velocity distribution of electrons in the transmitted beam is characteristic of the material bombarded. A homogeneous-field magnetic velocity analyzer, somewhat similar in principle to that used in the mass spectrometer, is then used to sort the transmitted electrons into streams of different radii, depending on the velocity. A photographic plate can be exposed to the now sorted electrons, producing varying intensities on the plate similar to a light spectrogram.

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PROCESS EQUIPMENT NEWS

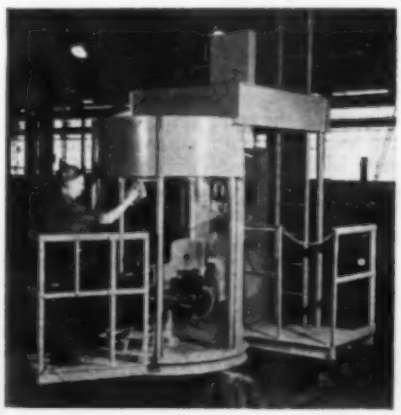
THEODORE R. OLIVE, Associate Editor

INCLOSED CRANE CAB

To IMPROVE the working conditions of crane operators who would otherwise be forced to operate in hot and dirty locations, the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has developed a new inclosed, air-conditioned crane cab for overhead traveling cranes which, as in the accompanying illustration, is of cylindrical shape with corners and blind spots eliminated. The transparent inclosure panels extend to the floor, permitting maximum vision in all directions over the area covered by the crane. The shatter-proof plastic panel are impervious to the gases ordinarily encountered. The operator is allowed to sit down at the job with all controls located for greatest convenience. Although there is a job for each of his hands and feet, none of his limbs need to serve double duty as in most conventional cabs.

The air cooling unit, especially designed for this cab, is claimed to provide clean fresh air at any normal temperature desired. The unit attached to the cab illustrated is for use at temperatures not exceeding 140 deg. F. A novel feature is the traveling platform which can be rotated around the cab, serving both as a means of entrance and as a platform for cleaning the windows. The new cab may be furnished with any new crane employing magnetic control, and can also be applied to existing cranes of any make.

Air-conditioned traveling crane cab

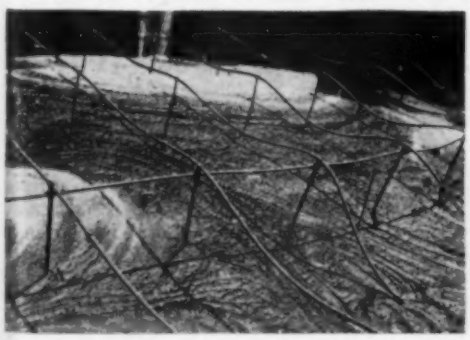


RECORD TEST FIRE

WHAT is claimed to have been the largest test fire on record was a fire recently set in a 93-ft. diameter crude oil tank at the Moorhead tank farm of the Standard Oil Co. of Ohio, Findlay, Ohio. According to Pyrene Development Corp., 560 Belmont Ave., Newark 8, N. J., the effectiveness of newly developed fire-fighting equipment was amply demonstrated before the naval, military and government officials present when the flaming crude oil, having reached a temperature of over 2,000 deg. F., was extinguished in exactly four minutes, two and one-half seconds, by the use of air foam pumped into the tank at the rate of 15,000 g.p.m. from applicators of a new auto-induction system developed by Pyrene. The foam compound was contained in 55-gal. drums from which suction lines fed into water pipes. These pipes carried the foam compound to foam-makers outside the oil tank where air was introduced into the mixture of water and compound. Using one part of compound to approximately 20 parts of water, the mixture expanded to about 320 gal. of foam per gallon of compound. The accompanying view taken inside the tank shortly after the fire was extinguished shows the layer of foam several inches thick completely blanketing the oil. Evidence of the high temperature reached is shown in the distortion of the foam introduction pipes.

New table top spray dryer

Foam layer in oil tank after extinguishment



Tubular portable dust collector

SMALL SPRAY DRYER

DEVELOPED to fit on to a table 3 ft. long and 6 ft. wide, a new laboratory spray dryer has been announced by Bowen Research Corp., Garwood, N. J. Of the same general design and construction as this concern's full-scale spray drying plants, the unit is said to be carefully engineered and to give results which are comparable to full-scale units. The dryer is said to be particularly useful in facilitating the evaluation of the pre-drying steps required in handling new materials or new processes. It is claimed to be suitable for nearly all aqueous solutions and slurries, requiring a drying time of only a few seconds so that a quart or two of solution can be changed to dry powder, ready for examination, in only a few minutes.

The unit is simple to operate and readily cleaned. From one position the operator can observe and control the rate of feed, air inlet temperature, drying operation, air outlet temperature, condition of the drying product and quantity of the finished product.

DRUM UP-ENDER

FOR UP-ENDING loaded barrels and drums, so that they may readily be picked up with a barrel truck, the Colson Corp., Elyria, Ohio, has introduced an up-ending truck of new design. The device is a compound arrangement of levers mounted on a pair of small wheels for transportation and use. The two hinged lifting arms are wheeled under the barrel or drum, a foot is placed on a step attached to the device, and by pulling back the handle the hinged arm contacts the drum surface in three successive steps while the fulcrum point on the axle moves under the load and the load is lifted in easy stages until it is almost upright. When the load has been lifted the maximum distance permitted by downward movement of the handle the drum is practically balanced on the chime and a slight forward push sets it on its end. This device has been provided to supplement the regular barrel and drum handling truck manufactured by this company.

TUBULAR DUST COLLECTOR

AVAILABLE in three sizes, a new tubular Dustex dust collector has been announced by the Dust Filter Co., 160 North La Salle St., Chicago 1, Ill. By using more filter

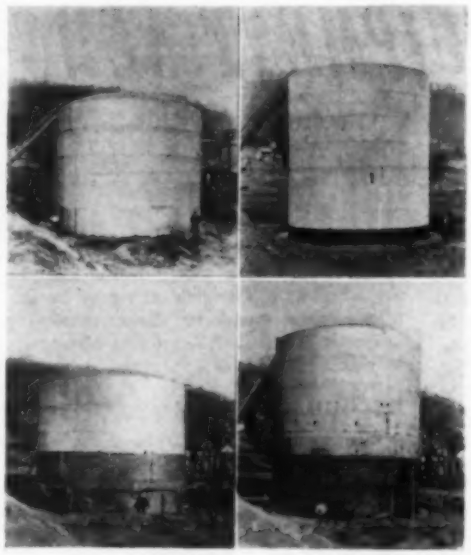
surface in proportion to the air volume than is customary, the new filter is claimed to collect dusts and lint more efficiently than usual. These units are portable and self-contained, for installations where a comparatively small amount of dust collecting capacity is required. The largest unit contains 60.8 sq.ft. of filter area and the smaller units, proportionately less. This area, said to be many times that of other standard units for the same capacity, is claimed to prevent minute particles from filtering through, while it also diminishes the static pressure loss. No collector bags are used, the filtering surface being of cloth tubes which are bottomless. Periodic manual-shaking eliminates the need for opening for cleaning. The units weigh from 150 to 250 lb., and are 36 to 48 in. high. Motors of ¾ and 1½ hp. are employed. A large muffler to deaden air noise is provided at the air discharge.

TANK ENLARGEMENT

FOR THE first time, it is claimed, it is now possible to enlarge liquid storage tanks to as much as twice the original size without dismantling the original structure. This is possible through a new technique developed by the Stacey Bros. Gas Construction Co., Cincinnati, Ohio.

The new method is remarkably simple and effective. First, the existing tank shell is cut at its base and a new shell is built around the old structure to the desired added height. Water is then run into the tank up to the new shell level so that compressed air may be introduced to float the old shell up to the new level. During this operation various controls hold the tank steady and level to ¼ in. Then a filler plate is inserted between the shells and the two units are tack-welded into place. When the air pressure is released and the water drained from the tank, the two shell sections and the filler are completely seal-welded on the outside. Inside, the old shell is trimmed and welded at intervals around its circumference and the enlarged tank is then ready for connections and service.

The several steps in this job are well illustrated in the four accompanying views. The upper pair show the original 300,000-gal. tank at the left, and at the right the tank enlarged to 425,000 gal. ten days later. The pair below show steps in this process. At the left the new section has been completed at the end of the fifth day, and at the right (at the end of the seventh day), the raised original tank has been welded to the new section, ready for painting and connections.



Steps in enlargement of a 300,000-gal. petroleum storage tank

Poly phosphate comparator

Climax electronic heater

Compression-transfer molding press

PHOSPHATE COMPARATOR

LOW CONCENTRATIONS of the poly (glassy) phosphates such as hexameta, pyro, septa, etc., are coming into extensive use, as for example in the threshold treatment of water. These materials are being used to prevent feed line deposition and pipe corrosion. To permit their determination in a reasonable time, W. A. Taylor & Co., 7300 York Road, Baltimore 4, Md., has developed a new poly phosphate comparator. Previous methods, it is stated, have required several hours to convert the glassy phosphate to the ortho form. The new method, it is stated, requires only 20 minutes. After conversion, two reagents are added separately and the blue color is compared with a standard. This gives the total phosphate content. A determination on the cold sample, without boiling, gives the ortho present in the sample. The difference is the poly phosphate. All necessary equipment is contained in a wooden carrying case 9¼ by 6¼ by 9 in.

ELECTRONIC HEATER

ENTRY of the Climax Engineering Co., Clinton, Iowa, into the electronic heating field has been announced by the company. Its new Electronic Division will manufacture 12 models of standard electronic heaters available in types for both induction and dielectric heating. The former is provided for the heating of conducting materials, and the latter for non-metallic materials such as chemicals, rubber, plywood, plastic materials, and so on. The manufacturer claims advantages through uniform heating, no redistribution of moisture, less handling, speedier production.

PLASTIC MOLDING PRESS

FOLLOWING many years of manufacture of similar equipment, the French Oil Mill Machinery Co., Piqua, Ohio, has announced a newly designed molding machine which is a combination compression and transfer molding press. The unit is self-contained with the hydraulic pumping equipment built into the bed of the machine. The design has been refined and an approved color combination has been used in painting the equipment for added safety and lessened operator fatigue. A fully automatic cycle controller is provided, enabling timing intervals to be chosen and changes from one-type of molding to another to be made instantly. The rapid action of the press, coupled with the use of preheated preforms, permits maximum production speed. The idle closing speed of the press is 300 in. per min. The 100-ton press is powered with a 5-hp. motor and the 200-ton press with a 7½-hp. motor.

SPRAY DRYING NOZZLE

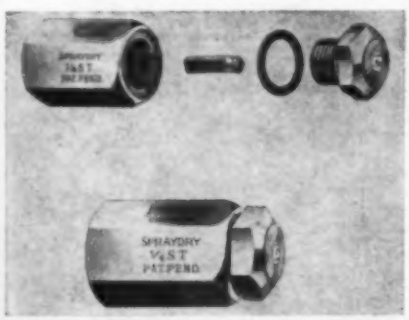
MANY different capacities are available in an improved line of spray drying nozzles, designated as ¼ ST and recently announced by Spraying Systems Co., 4023 West Lake St., Chicago 24, Ill. For example, it is claimed that if a dryer is set up to use a pressure of 5,000 lb. and it is desired to spray exactly 53 gal. per hour per nozzle, it is possible to select from the list available a nozzle having exactly this capacity at this pressure. It is claimed that these nozzles are designed to provide the finest possible atomization at the given pressure. They employ renewable cores and orifice inserts, the latter

heat treated and lapped, and available in either hardened steel or tungsten carbide with flat or cup tops. The spray pattern is a hollow cone with the spray angle predetermined for each nozzle size. The company has available complete tables showing capacities and pressures ranging from 1,000 to 7,000 lb. on 85 separate combinations of orifice and core sizes.

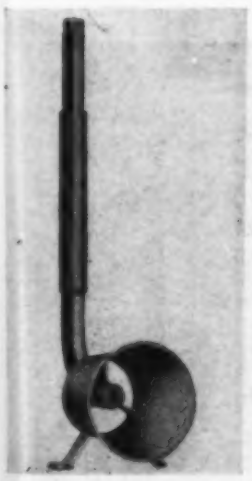
JET AGITATOR

An improved type of jet for agitating and circulating the content of tanks and vats, which operates on steam, air or solution, has been announced by the Youngstown Welding & Engineering Co., Youngstown, Ohio. The device has already been applied successfully, according to the manufacturer, in pickling tank installations and is now being offered for other applications in the process industries. By installing the new Weldco jet in the corner or anywhere along the sides of a tank the manufacturer claims that the entire contents can be agitated and mixed. The jet is readily installed in any present air or steam line. Its design is such that the velocity of the motive fluid increases as it passes through a special nozzle and expands into a bell-shaped housing shown in the accompanying illustration. This action sucks solution from the tank through the back of the jet, discharging it forward. This equipment is available in various welded constructions of corrosion-resisting metals, including Monel, Inconel, nickel, stainless steel, or any other weldable alloy. It operates on any pressure of 10 lb. or more.

Four-part spray nozzle



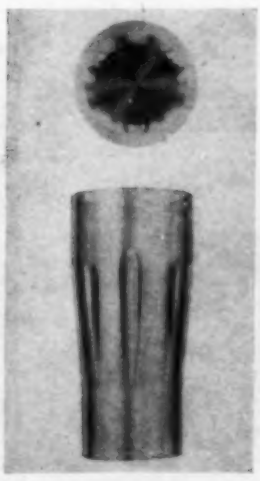
Corrosion resisting jet agitator



ROTAMETER TUBE

A new patented design of rotameter tube, designed to solve the problem of guiding the float, has been announced by Fischer & Porter Co., 918 County Line Road, Hatboro, Pa. The new design, known as the "Bead-Guide Tube," is constructed of boro-silicate glass, with three straight glass ribs running up the inside of the tube as shown in the accompanying illustration. There is only a hairline contact between the float and each rib. It is pointed out by the manufacturer that a guided float improves the accuracy of a rotameter by centering the float, while at the same time it prevents tube breakage. Furthermore, the use of a guide permits float shapes to be used which are unstable without guides, thus making it possible to use the company's Stabl-Vis float for measuring fluids of varying viscosity without the usual guiding arrangement. The new tube simplifies construction by eliminating the central guide wire often used for float stabilization. It also solves the problem of guiding the float when corrosive chemicals, such as HCl, are being measured. In addition, the ribs add materially to the strength of the tube. For these reasons the manufacturer expects that the new design eventually will displace the present tension-guide wire construction and the old style rotameter tube. The new tube can readily be adapted to existing rotameters.

Rotameter tube with internal beads



WATER SUPPLY PUMP

One of a series of new Straight-Flo Pumps, manufactured by Morris Machine Works, Baldwinsville, N. Y., and supplied to the Rubber Reserve Co.'s butadiene plant at Port Neches, Texas, is shown in an accompanying illustration. Driven by a 350-hp. motor, these pumps deliver 72,000,000 gal. per day each from their 48-in. diameter discharge pipes. For large-capacity, low-head work, the pumps supply river water for cooling purposes in the plant.

CARBON BEARINGS

Morganite Brush Co., Long Island City 1, N. Y., has developed a line of self-lubricating bearings available in compositions of carbon, graphite, or both. If necessary, these bearings can be supplied with various metallic contents for special applications. Not only are they self-lubricating, but the bearings are also immune to acids, alkalis and most solvents. Having low coefficients of friction and expansion, it is claimed that they wear negligibly and also do not wear the contacting surfaces appreciably. Such bearings are readily machinable, but may be molded with tolerances to 0.001 in. They can be supplied machined to close accuracy or superfinished, if desired. Outside diameters from ¼ to 15 in. are available, and any shape desired can be supplied. Operating speeds to 50,000 r.p.m. with thrust loads to 30 lb. per sq.in. are claimed, or loads to 2,000 lb. per sq.in. at slower speeds. The bearings may be operated at temperatures as high as 850 deg. F. in such applications as steam turbines, drum dryers and paper mills where ordinary lubrication may be impaired or may contaminate the product.

72,000,000 G.P.D. low-lift pump

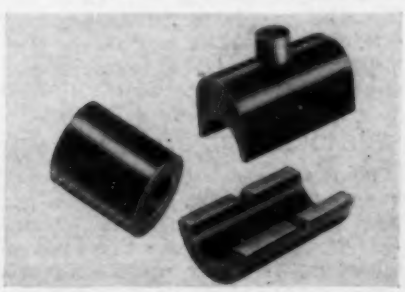
EQUIPMENT BRIEFS

Higher sustained bright light and a 40 percent greater capacity are claimed for an improved rechargeable flashlight battery recently announced by the Ideal Commutator Dresser Co., 1344 Park Ave., Sycamore, Ill. Since the introduction of this concern's original rechargeable battery five years ago, much experience and investigation has resulted in the improvements available in the new battery. The new one, having three plates instead of two, is claimed to make possible savings of up to $10 per year and to outlast 400 dry cells.

According to the Cooper-Bessemer Corp., Mount Vernon, Ohio, it is now possible for the first time to supercharge a gas engine. Thus the same engine can produce a greater power output. It is also possible with engines of this type to convert instantly from the use of either oil or gas fuel to the other fuel. In a test of one of the company's gas diesel engines having an ordinary rating of 1,100 hp., the engine was supercharged up to a rating of 1,600 hp. at 327 r.p.m. Changing the engine from oil to gas, which could be done at full load, resulted in lower exhaust temperature and a decrease in the turbocharger speed. This evidently was due to better combustion with gas than with oil.

Simultaneous readings of current and voltage are possible with a new voltammeter, Model 601, manufactured by Associated Research, 231 South Green St.,

Self-lubricating carbon bearing



Chicago 7, Ill. The instrument combines an a.c. voltmeter and an a.c. ammeter, the former for currents from 0.2 to 500 amp., in eight current ranges; and the latter for voltages from 30 to 600 volts, in three ranges.

A RECENT improvement in its surface pyrometer has been announced by Cambridge Instrument Co., Grand Central Terminal, New York 17, N. Y. The instrument employs a redesigned plastic case of better appearance, easier to keep clean than the previous metal case. It is also unaffected by corrosion and simplifies the problem of electrical insulation, making possible several mechanical improvements. An unbreakable window of Lucite replaces the usual glass pane, and, by extending over the top of the instrument, gives better illumination of the scale and thus facilitates accurate temperature reading, particularly when the light is poor.

DESIGNED some two years ago for naval and merchant marine vessels, an improved relief valve manufactured by the Ferris Engineering Co., Palisades Park, N. J., and known as Type 1000, is now available for industrial use. The diaphragm used acts in several capacities. It not only seals the valve from leakage encountered around the stem in conventional designs, but also opens the valve fully at 20 percent overpressure, rather than the approximate 35 percent in conventional type relief valves which depend on pressure under the disk to lift the disk. Since the diaphragm is much greater in area than the disk, the available force is many times multiplied. This construction also permits the valve to close at the set pressure, whereas the disk type goes below the set pressure by about 15 percent before the spring recovers from its momentary hysteresis and closes.

MAXIMUM PROTECTION for the operators of lift trucks in cases where there is danger from falling objects is afforded by an overhead guard now available to fit all models of the Towmotor lift truck manufactured by Towmoter Corp., Cleveland, Ohio. Constructed of rugged steel tubing and easily installed, the guard is in two sizes. Only about 10 or 15 minutes is required for installation by means of the bolts and clamps which are furnished. The only needed tool is a wrench.

WIDE EXPANSION in the sizes and styles available in its cored and solid bar stock Oilite materials has been announced by Chrysler Corp's Amplex Div., Detroit 31, Mich. These oil-impregnated, powdered-metal products are available in bronze and ferrous-base metals, in sizes ranging from ⅛ to more than 12 in. in diameter. The material may thus be had to cover a wide variety of bearing requirements.

SPREADER TYPE STOKER

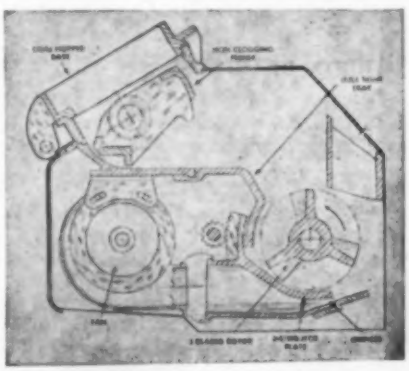
FOR USE on industrial boilers ranging upward from 75 hp., Johnston & Jennings Co., 875 Addison Road, Cleveland 14, Ohio, has introduced a new mechanical-pneumatic spreader type stoker which is adjustable for various operating conditions and is said to afford positive prevention of spillage of fines along the front of the stoker. As shown in the accompanying cross section, a three-bladed rotor receives the coal from a feeder tray and discharges it into the furnace off the end of a distributor plate, the position and slope of which can be adjusted to meet requirements of different size furnaces. A small high-velocity fan mounted behind the rotor, discharging through orifices under the distributor plate, catches the fines and distributes them also to all parts of the furnace, thus overcoming any tendancy for the fines to dribble down on to the furnace hearth. This is said to produce an even, homogeneous fuel bed.

All exposed parts of the stoker are air cooled. Stokers are mounted on to the cast iron boiler front with four hinge pins, two on each side, permitting two pins on one side to be removed readily, thus enabling the entire stoker to be swung out for quick and easy inspection and repair or adjustment. Four standard sizes, having 16, 20, 24 and 32-in. long rotors, may be installed singly or in multiple.

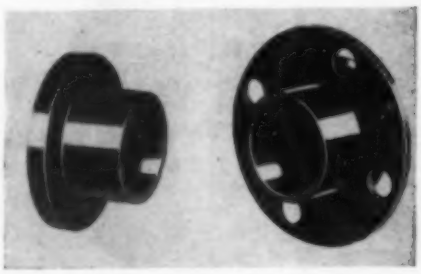
ROTATING SEAL

PRESSURES up to 5,000 lb. per sq.in., at speeds from less than 1,000 to more than 4,000 r.p.m., are claimed to have been held successfully by a new type rotating seal for centrifugal pumps and similar purposes developed by Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill. Known as the Spring-life Gyro-Seal, the new seal requires no auxiliary springs in application since the inherent spring of the bellows used is, in most cases, sufficient to maintain the required pressure on the sealing surfaces. The bellows can be made of various types of metal to suit the conditions of each application. Seals of this character can operate on either external or internal pressure. Lapped finishes of the sealing members can be furnished to meet specifications wherein one light wave of flatness is required.

Mechanical-pneumatic spreader stoker



Plastic Van Stone joint



PLASTIC PIPE JOINT

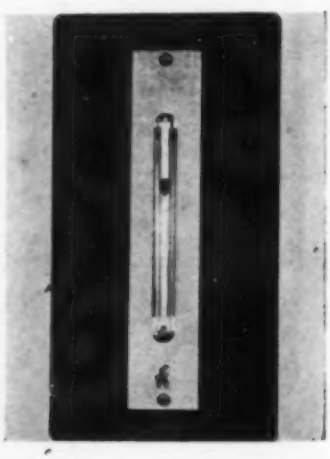
IN LINE with the trend toward the use of larger diameter plastic piping in numerous corrosion resisting applications, the Commercial Plastics Co., 201 North Wells St., Chicago, Ill., has introduced a plastic Van Stone type joint-flange consisting of a flanged endpiece which is heat-welded on to the plastic pipeline, and a steel ring for bolting on to a similar joint-flange to which the end is to be connected. The new joint-flange is now available in sizes to fit several sizes of pipe up to 4 in. in diameter. It is suitable for installations requiring both acid and alkali resistance and is used wherever a flanged connection is required to afford a quick means for disassembling the line.

PANEL-MOUNTED METER

MEETING the need for panel centralization of instruments to indicate pressure, flow, temperature, etc., Schutte & Koerting Co., Philadelphia, Pa., has announced a new panel-mounted rotameter which, although basically this company's Universal rotameter design, has a frosted glass window with a central clear glass aperture exposing the meter tube which is installed flush with the panel board, with the rotameter supported directly behind. Provision is readily made for back-lighting and ready maintenance accessibility.

Bellows type rotating seal

Panel-mounted rotameter



CHEMICAL ENGINEERING NEWS

CHEMICAL RESEARCH GROUP HEADED BY JAMES G. PARK

FORMAL organization of The Chemical Market Research Association was accomplished at a meeting of chemical market research executives and economists, held last month at the Biltmore Hotel, New York. Officers for the coming year were elected as follows: James G. Park, president; Richard L. Davies, vice president; William M. Dennis, treasurer; Richard Lawrence, recording secretary; Frank M. Waldo, corresponding secretary; and George Gollop and James H. Boyd, councilors at large.

Objectives of the association are the advancement of chemical market research in theory, practice and application, and the maintenance of high ethical standards among its membership. Starting in 1939 as an informal discussion group when it was apparent that market research was becoming increasingly important to the chemical industry, attendance grew to such an extent that organization as a semi-professional association became desirable.

The June meeting was divided into two sessions. In the afternoon, following the business meeting, Lawrence Brown, deputy director of the Chemicals Bureau of the War Production Board spoke on "Reconversion and the Chemical Industry." In the evening, Sidney D. Kirkpatrick, editor of *Chemical & Metallurgical Engineering* who recently visited Germany on behalf of the government, gave a talk on his trip through Germany.

MUTUAL CHEMICAL TO MAKE BICHROMATE IN LOUISIANA

A SHORT time ago it was announced that a project had been officially approved for converting an idle magnesium plant at Lake Charles, La., for the manufacture of bichromate of soda. A more recent announcement states that the War Production Board has awarded to the Mutual Chemical Co. of America a project for building a bichromate of soda plant at Lake Charles. The plant is being built and will be operated by Mutual for account of Defense Plant Corp. and should be in production in the early part of 1946. The firm of Sanderson & Porter has been engaged by Mutual as engineering contracters and is working on the construction and the adaptation of existing facilities now owned by DPC.

ATLAS POWDER PLANS NEW LABORATORY UNITS

AN appropriation of $400,000 for the construction of new units to expand the research facilities of Atlas Powder Co. at Wilmington, was approved at a recent meeting of the board of directors of the company. M. J. Creighton, general manager of the industrial chemicals department stated that construction of four new buildings at Central Research Laboratories would start as soon as approval had been obtained from the War Production Board. The new buildings will be designed for process development on a semi-work scale, to work out methods of manufacture preparatory to large-scale production. The new units will be concerned with the development of organic chemicals and their uses. Research on explosives will remain at Reynolds Experimental Laboratory near Tamaqua, Pa., and research on coated fabrics and industrial finishes at Stamford, Conn.

DEFENDANTS ACQUITTED IN PLASTICS ANTI-TRUST SUIT

A FEDERAL Court in Newark, N. J., on June 20 acquitted the E. I. du Pont de Nemours & Co. and the Rohm & Haas Co. and six executives of the two companies of charges of international conspiracy under the anti-trust act. According to the charge, the conspiracy consisted in the participation of the two companies in agreements with producers of acrylic plastics products in Germany and England with a purpose of fixing prices, monopolizing production, and controlling distribution by allocating sales territories in all parts of the world. Two counts of the indictment, charging monopoly and conspiracy to monopolize, were dismissed at the instance of the prosecution before the case opened. A separate indictment concerning monopoly and restraint of trade in the denture field also was quashed.

CHEMICAL SHOW POSTPONED UNTIL NEXT YEAR

IN conformity with the wishes of the Office of Defense Transportation, it has been decided to defer plans for holding the 19th Exposition of Chemical Industries which had been tentatively scheduled for Madison Square Garden, New York, next December. Charles F. Roth, manager of the Exposition, has not set any new date but if transportation conditions permit, it probably will be held sometime in the early spring.

PAPER is a number 1 war material shortage—because over 700,000 different war items are wrapped, packaged, labeled, tagged, or made from paper or container board. The Pacific war will require stupendous amounts of it. So please do this extra bit to speed victory:

Share this magazine with your associates. Because of the paper shortage, the number of copies is limited.

Organize for a continuous drive in your office and plant to collect waste paper of any kind to put into paper salvage.

DUPONT EXPANDS ACTIVITIES ON PACIFIC COAST

APPOINTMENT of Albert R. Tucker to the newly created position of West Coast manager of the electrochemicals department of E. I. du Pont de Nemours & Co. has been announced by F. S. MacGregor, general manager of the department. Mr. Tucker had been district manager for the company at Philadelphia since 1936 and is succeeded there by Frederick C. Schumacher. The El Monte plant and sales office and the district sales office at San Francisco will be consolidated under Mr. Tucker.

Expansion of activities in the region is being undertaken, Mr. MacGregor said, because of the rapid pace of industrial development in California and the Pacific Northwest with consequent increased demands for formaldehyde, ceramics, cyanides, peroxides, metallic sodium, and chlorinated solvents. Salesmen covering the citrus orchard area and technical service representatives for the electroplating, dry cleaning and degreasing fields will have headquarters at El Monte. Resident salesmen will be established at Seattle, San Francisco, and Los Angeles.

UNITED STATES RUBBER CO. OPENS TEMPORARY PLANT

THE United States Rubber Co. is operating a plant in Berlin, N. H., for the production of life vests for the Navy. The new facilities will augment the output of the plants at Providence, R. I., and Manchester, N. H., where labor shortages have handicapped operations. Officials of the company emphasize that no plans have been made for establishing a permanent plant in Berlin for production of postwar products.

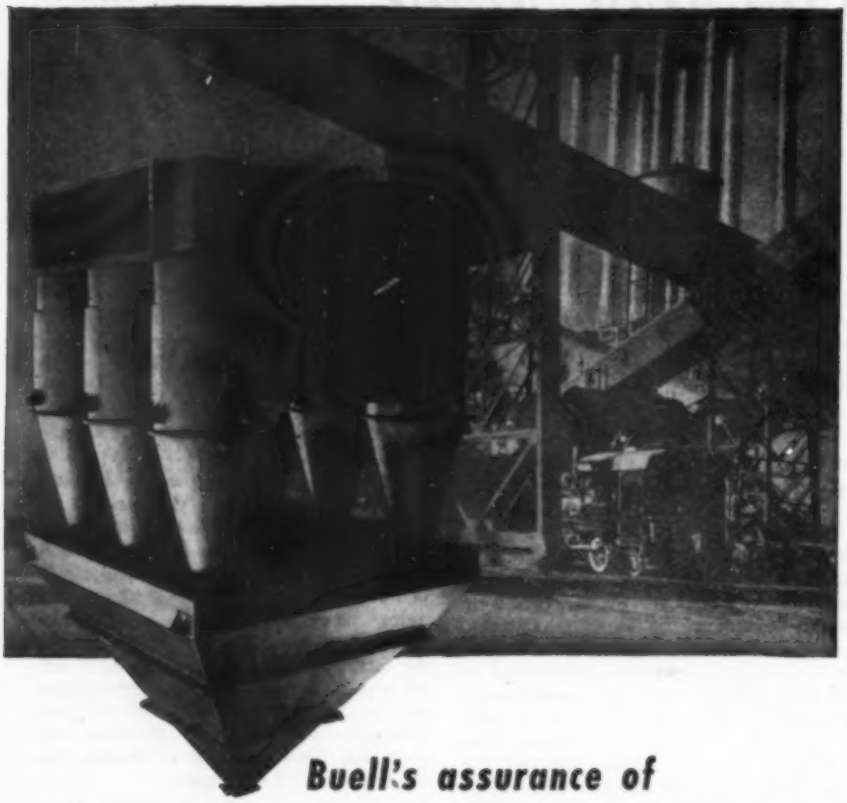
LITHOGRAPHIC RESEARCH AT ARMOUR FOUNDATION

THE Lithographic Technical Foundation will locate research activities at the Armour Research Foundation of Illinois Institute of Technology about August 1, according to a joint announcement by Dr. Jesse E. Hobson, director of Armour and E. H. Wadewitz, president of the Technical Foundation. An extensive research program embodying many of the major projects of the Lithographic Foundation, has been carried on at Armour since August 1944 under the direction of Dr. Martin H. Heeren, assistant director.

MACINTOSH HEADS NEW YORK PURCHASING AGENTS

AT THE annual meeting of the Purchasing Agents Association of New York, held on June 19, Harold M. Macintosh, L. O. Koven & Bro., Inc., was elected president. Other officers elected were Frederic W.

EXTRA STURDY CONSTRUCTION



Buell's assurance of
HIGH EFFICIENCY, LOW MAINTENANCE, LONG LIFE

BUELL (van Tongeren) Dust Collectors have been in use for five or more years without a failure, without the replacement of a part. Many installations having been in continuous use under the most exacting operating conditions and at high working temperatures.

This recognized ability to withstand wear, heat and vibration is due to Buell's extra-sturdy construction. Fabricated of extra thick steel, completely seal-welded inside and out, with welds ground to a flush smooth surface, Buell bodies and cones are as "tight" as a casting. Buell hoppers, for example, have a reputation for especially rugged construction; braced and stiffened with 3" channels that offer strong resistance to vibration.

Finally, because Buell provides this *needed* ruggedness, Buell (van Tongeren) performance is always dependable.

BUELL FEATURES

SHAVE-OFF
LARGE DIAMETERS
EXTRA-STURDY CONSTRUCTION
CORRECT HOPPER DESIGN
SPLIT-DUCT MANIFOLDS
INNER WELDS GROUND SMOOTH

RESULT IN

HIGH COLLECTION EFFICIENCY
LESS FAN BLADE WEAR
LOW DRAFT LOSS
LOW POWER CONSUMPTION
HIGH TEMPERATURE RESISTANCE
UNLIMITED CAPACITY
NO MOVING PARTS
FREE DUST FLOW

PRODUCE

HIGH EFFICIENCY
LOW MAINTENANCE
LOW OPERATING COST
LONG LIFE
NO CLOGGING

buell
DUST RECOVERY SYSTEMS

Engineers and plant executives will find much of interest in Buell's 32-page book:
"The van Tongeren System of Industrial Dust Recovery"

BUELL ENGINEERING COMPANY, INC.
18 Cedar Street, New York 5, N. Y.
Sales Representatives in Principal Cities

DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

Thomas, Worthington Pump and Machinery Corp., vice president; Harold G. Butterfield, National Union Radio Corp., vice president; and Edward B. Fielis, treasurer. J. H. Leonard is executive secretary. Members of the executive committee are G. W. Howard Ahl, Columbia Ribbon & Carbon Mfg. Co., Inc.; Donald H. Lyons, Johns-Manville Corp.; John F. Snedeker, Binney & Smith Co.; and Harold T. Moffett, The National Lock Washer Co.

STANDARD OIL OF INDIANA REGROUPS RESEARCH STAFF

As part of its preparation for postwar activities, Standard Oil Co. of Indiana, through Bruce K. Brown, vice president, has announced a regrouping of its research and development staff. The changes follow the recent election of Mr. Brown to the office of vice president in charge of development and the promotion of Joseph K. Roberts to the position of general manager of research. In order to coordinate the research work more closely with that of other departments, two associate research directors have been moved from the laboratories in Whiting, Ind., to the general office in Chicago. D. P. Barnard, while continuing his technical assignments, will undertake liaison with the sales department. J. H. Forrester will move to Chicago as general supervisor of technical service and product inspection activities for all refineries.

At the Whiting laboratories, M. T. Carpenter has been appointed to the new position of executive director. R. C. Guness has been raised to the rank of associate director. R. N. Giles has been promoted to the new position of superintendent of the technical service division. A. B. Brown has become assistant superintendent in charge of technical service on heavy oils. C. R. Harte has been made assistant superintendent in charge of the work on light oils technical service and also will continue to supervise economic studies.

CORDLE BECOMES DIRECTOR OF IODINE BUREAU

Appointed vice president and director of the Iodine Educational Bureau, Inc., of New York, Harry J. Cordle assumed his new duties on July 2. He succeeds Herbert C. Brewer with whom he had been associated for a number of years. Mr. Brewer resigned as director of the Bureau in order to devote himself to the activities of the Chilean Nitrate Educational Bureau, Inc.

WARD V. EVANS TO RECEIVE 1945 HONORARY SCROLL

The 1945 Honorary Scroll Award of the American Institute of Chemists will be given to Ward V. Evans, chairman of the Department of Chemistry at Northwestern University. Gustav Egloff in making the announcement said the presentation would be made by the Chicago Chapter at a meeting to be held in the fall.

Professor Evans will receive the honor for his outstanding achievements in the field of chemistry, as a great teacher, as

METHYL ETHYL KETONE

$CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$

Molecular Weight 72.10

Methyl Ethyl Ketone has superior solvent properties . . . sufficiently low boiling point to permit ready recovery. It is not subject to hydrolysis and thus does not form acids corrosive to metals.

MEK is valuable in lubricating oil dewaxing because of its high solvent powers for oil.

MEK forms coating, dipping and spraying compositions with certain vinyl and cellulose resins. Thus it helps to make raincoats, tents, artificial leather for handbags and luggage, bathing suits, oilcloth, etc., stronger, better-wearing, water-proof and scuff-resistant.

MEK is important as a solvent in the manufacture of rubber cement widely used in fabricating bullet-proof gas tanks. Its excellent solvent properties are also valuable in the printing and lithographing industries.

Consider MEK in the light of your own processes. It may provide the answer to a problem.

SPECIFICATIONS

Purity	Minimum 99% methyl ethyl ketone by weight
Specific Gravity 20°/20° C.	0.805 to 0.807
Color	Maximum 10 platinum cobalt (Hazen) standard
Water	Miscible without turbidity with 19 volumes of 60° Bé. gasoline at 20° C.
Acidity (other than carbon dioxide)	Maximum 0.003% calculated as acetic acid
Distillation Range (A.S.T.M. D268/33)	Below 79° C. None Above 80.5° C. None
Non-volatile Matter	Maximum 2 mg. per 100 ml.
Weight	6.72 lbs. per gal. at 20° C. (approx.)

PHYSICAL PROPERTIES

Several of the physical properties of methyl ethyl ketone are given in the following table:

Specific Gravity at 20°/4° C.	0.8047
Boiling Point at 760 mm.	79.6° C.
Melting point	–86.4° C.
Flash point, Tag Open Cup	34° F.
Tag Closed Cup	28° F.
Vapor Pressure at 0° C.	24.3 mm. Hg.
10° C.	42.5 " "
20° C.	71.2 " "
30° C.	114.3 " "
Specific Heat	0.55 (20° to 78°C.)
Latent Heat of Vaporization	106.0 gm. cal. per gm. (20° C.)
Refractive Index, N_D^{20}	1.3788
Coefficient of Expansion	0.00076 per °F.
Explosive Limits of Vapor with Air	
Upper	10.2% methyl ethyl ketone
Lower	1.97% methyl ethyl ketone
Miscibility	Complete with nearly all organic liquids

Water azeotrope containing 88.7% by weight of MEK boils at 73.4° C. Also forms azeotropes with some of common lacquer solvents.

For further properties and uses communicate with either of the addresses below.

SHELL CHEMICAL Division of SHELL UNION OIL CORPORATION
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Can the Wire Cloth YOU ARE BUYING Stand this Test?

Fine cloth, to the eye may look all right but how does it look under the cloth testing counting glass? Is it uniform in weave? Is the mesh count correct?

When processing calls for a fine cloth of a certain mesh, usually little deviation is permissible. The wire cloth assumes a role of considerable responsibility. If it isn't *all* right, the process suffers.

We invite all buyers of NEWARK Wire Cloth to make counting glass tests of our fine mesh cloth.

NEWARK for ACCURACY

NEWARK WIRE CLOTH COMPANY

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an industrial consultant, and for his high civic spirit. A national authority on explosives, Professor Evans will retire from Northwestern on September 1 after having been a member of the faculty since 1916. During World War I he served as an expert in the testing of high explosives with the U. S. Bureau of Mines.

ASTM ELECTS OFFICERS AT BUSINESS SESSION

Due to prevailing restrictions, the forty-eighth annual meeting of the American Society for Testing Materials took the form of a condensed business session held in New York on June 27. The principal action taken was to approve the tellers' report on the election of officers for the coming year. The new officers are J. R. Townsend, Bell Telephone Laboratories, Inc., New York, president; and T. A. Boyd, General Motors Corp., Detroit, vice president.

Members of the executive committee are J. R. Freedman, Jr., American Brass Co., Waterbury, Conn.; L. J. Markwardt, United States Forest Products Laboratories, Madison, Wis.; C. H. Rose, National Lead Co., Brooklyn; L. P. Spalding, North American Aviation, Inglewood, Calif.; and W. A. Zinzow, The Bakelite Corp., Bloomfield, N. J.

CELANESE CORP. ESTABLISHES FELLOWSHIP AT PRINCETON

A joint announcement on June 18 made known that the Celanese Corp. of America has established a fellowship in chemical engineering at Princeton University. The fellowship is for a term of five years from the time of the appointment of the first recipient.

CEMENT COMPANIES CITED IN ANTI-TRUST SUIT

On June 28, charges were filed in Denver, accusing 89 producers of portland cement and the Cement Institute with violating the Sherman Anti-Trust Act. The producing companies operate plants throughout the country and account for all but a small part of total domestic production. They are charged with conspiracy to fix and maintain prices and to eliminate all competitive factors in the sale of cement.

OIL COMPANIES TO DEVELOP INDUSTRY IN COLOMBIA

Owned jointly by the Sinclair Oil Corp., Cities Service Oil Co. of Pennsylvania, and Richfield Oil Corp. of California, The Tri-Pet Corp. has been formed to develop production of petroleum in foreign fields. The new corporation has organized a subsidiary to operate in Colombia under the name of Companias Unidas de Petroleo. Application has been filed with the Colombian Government for concessions on national lands aggregating 760,000 acres and negotiations are under way for securing leases for additional lands from private owners. Officers of the Tri-Pet Corp. are L. V. Stanford, Sinclair Oil

No Oil to Cause Spoilage

CP Oil-less Cylinder Compressors have been developed for use where the air or gas compressed must be free from oil. No oil, grease or other cylinder lubricant is required. Piston and rod, completely supported by crossheads, are full floating, removing all weight from cylinder walls and stuffing boxes, thereby avoiding wear of carbon piston rings and hardened steel cylinder liner. Trouble-free operation and long life of wearing parts are assured. Only normal maintenance is required — no need for periodic rotation of piston rings.

CP Oil-less Cylinder Compressors are arranged for belt, motor or steam drive, in single stage and two-stage types. They are available in a wide range of sizes and ratings. Write for complete information.

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AIR COMPRESSORS
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LIFTING

For moving bales, boxes, crates, drums, barrels with limited manpower, the Reading Multiple Gear Chain Hoist provides a practical solution.

Loads up to 2 tons can be lifted by one man. The load brake holds positively till released. Where I beam trolleys are used, loads can be moved with ease by one man.

Long life is insured by the sealed-in-oil gear unit—an exclusive feature. The all steel construction from hook to hook gives high overload capacity — guaranteed 25% over rated capacity.

See your nearest Reading Hoist distributor for help on your materials handling problems or write direct.

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CHAIN HOISTS • ELECTRIC HOISTS
OVERHEAD TRAVELING CRANES

READING HOISTS

Corp, president; R. V. Whetsel, Cities Service Oil Co., vice president Marvin L. Gosney, treasurer; and J. Von Bevern, secretary.

U. S. NAVY ESTABLISHES NEW OFFICE OF RESEARCH

A NEW Office of Research and Inventions has been established by the United States Navy under the direct supervision of Secretary Forrestal. The new unit was created by merging the Naval Research Laboratory, the special devices division of the Bureau of Aeronautics, the Office of Research and Development, and the Office of Patents and Inventions. Rear Admiral Harold G. Bowen, formerly director of the Office of Patents and Inventions was selected to head the new organization and Capt. Luis de Florez, who had been serving as director of the special devices division of the Aeronautics Bureau, was appointed assistant chief.

Salt Sold or Used By Producers By Classes and Uses, 1943-44

Short tons

Use	1943 Evaporated	1943 Rock	1943 Brine	1944 Evaporated	1944 Rock	1944 Brine
Chlorine, bleaches, chlorates, etc.	1,138,691	770,620	746,982	1,141,408	806,010	917,938
Soda ash	2	110	7,157,534	.....	104	7,339,991
Dyes and organic chemicals	54,772	78,520	.....	67,116	46,114	.....
Soap (precipitant)	37,717	15,974	.....	54,218	22,402	.....
Other chemicals	131,674	376,376	*	98,260	414,233	.....
Textile processing	39,705	81,954	.....	40,171	81,247	.....
Hides and leather	103,728	191,014	.....	97,506	147,819	.....
Meat packing	459,503	375,815	.....	426,271	373,816	.....
Fish curing	32,724	53,463	.....	35,908	67,844	.....
Butter, cheese, and other dairy products	108,740	9,920	.....	105,174	9,503	.....
Canning and preserving	137,532	13,149	.....	146,182	13,210	.....
Other food processing	205,548	16,841	.....	206,150	17,424	.....
Refrigeration	31,841	179,152	.....	39,575	196,353	.....
Livestock	625,675	232,730	.....	550,975	213,999	.....
Highways, railroads, dust and ice control	12,912	283,131	.....	9,300	218,903	.....
Table and other household	480,682	184,843	.....	436,323	166,292	.....
Water treatment	174,460	200,018	*	165,024	184,427	.....
Agriculture	46,127	16,455	.....	53,622	11,156	.....
Metallurgy	43,794	31,099	.....	35,741	30,375	.....
Other uses†	127,982	147,945	56,599	233,607	427,007	68,383
	3,993,809	3,259,138	7,961,115	2,942,621	3,448,238	8,326,312

* Included under "Other Uses." † Includes also exports where use is not specified.

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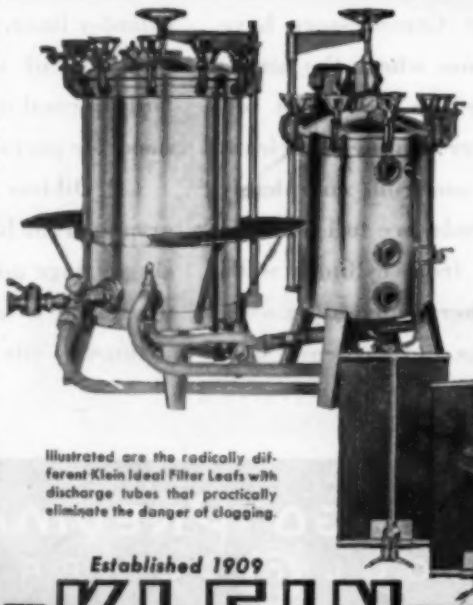
CHEMICAL PLANTS
FOOD PLANTS
..*Your* PLANT!

THERE IS NO OTHER *Filter* LIKE THIS



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KLEIN
IDEAL DIATOMACEOUS EARTH FILTERS AND SLURRY FEEDERS

Many important and exclusive improvements and radical innovations have been incorporated in the precision-built Klein Ideal Diatomaceous Earth Filters and Feeders. Constructed of stainless-steel they utilize a new exclusive filter principle that will bring you a new high in maximum efficiency, minimum maintenance and product uniformity.

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Life Expectancy . . .
Useful life of sleeves, liners and similar parts cast in iron can be greatly lengthened by suitable additions of Nickel to a properly adjusted base mixture. Counsel and data to help you in the selection, fabrication and heat treatment of ferrous and non-ferrous metals is available upon request.
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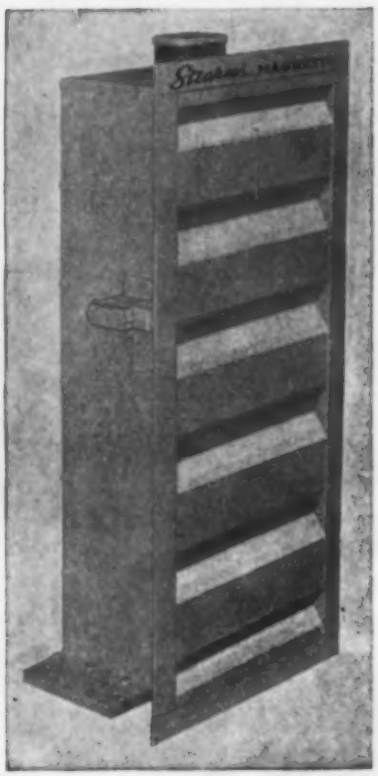

If you are bothered with tramp iron or metallic refuse in air blown material such as cotton, wool, shoddy, etc., investigate the merits of this thoroughly tried Stearns Air Duct Magnet. An efficient, strong, automatic piece of magnetic equipment designed by a pioneer magnetic engineering firm. Write for details.

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PULLEYS · BRAKES
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PACIFIC PROCESS INDUSTRIES

TRENDS • EVENTS • DEVELOPMENTS

JOHN R. CALLAHAM, Pacific Coast Editor, San Francisco, Calif.

PROCESS INDUSTRIES GROWTH IN CALIFORNIA REVEALED

EMPLOYMENT of wage earners in chemicals and allied manufacturing industries of California has increased almost 75 percent from 9,900 in 1939 to 17,200 in 1944, a survey by the California State Chamber of Commerce has just revealed. During the same period, employment in industrial chemical plants increased 86 percent to reach 7,800. The following table shows the growth of certain process and manufacturing industries in the state since 1939 in terms of employment of wage earners:

	1939	1944	Percent Increase
Chemicals and allied products	9,900	17,200	73.7
Paints and varnishes	1,500	1,800	20.0
Industrial chemicals	4,200	7,800	85.7
Petroleum products	9,500	13,700	44.2
Petroleum refining	8,600	12,400	44.2
Rubber products	4,900	15,700	220.4
Tires	3,000	10,100	180.6
Leather and leather products	2,400	3,500	45.8
Paper and allied products	5,400	7,100	31.5
Paper	2,200	2,500	13.6
Converted paper products	3,200	4,600	43.8
Glass and glassware	1,800	3,200	77.8
Cement	1,500	1,900	26.7
Non-ferrous metals	5,800	17,300	198.3
Electrical mach. and equip.	3,900	15,200	289.7
Other machinery	13,300	45,800	244.4
Total manufacturing wage earners	276,300	824,400	198.4

NORTHWEST INCREASES OUTPUT OF NITRATION-GRADE PULP

CLOSE to four times as much wood pulp was used in producing smokeless powder during last year as for 1942 and probably 85 percent of this pulp has been supplied by Pacific Coast mills. Pacific Northwest concerns already in the program are the Soundview Pulp Co., Everett, Wash., Weyerhaeuser Timber Co., Longview, Wash., and Rayonier, Inc., Hoquiam, Wash. Now entering into the munitions pulp program is the Everett mill of Weyerhaeuser Timber Co., while the large Rayonier mill at Shelton, Wash., will probably be operated for the same purpose later this year.

PRINTING INK FIRM OPENS WESTERN DIVISION

WITH headquarters in San Francisco, a west coast division has been opened by the General Printing Ink Corp. The new office, headed by William J. Egan, will coordinate activities formerly handled by the three divisions of the corporation, the Fuchs & Lang Manufacturing Co., the George H. Morrill Co., and the Sigmund Ullman Co.

NEW PLASTICS FIRM IN LOS ANGELES

RECENTLY organized to produce plastic materials and chemicals from furfural, the Furane Plastics & Chemicals Co. has established its office and manufacturing plant at 5233 West San Fernando Road, Los Angeles 26, Calif. Initial production will be devoted to the preparation of high-strength, cold-setting adhesives for plastics and rubber products. The firm's first new product, Resin X, is claimed to be the first commercial development solely from furane derivatives.

OIL-SHALE DEMONSTRATION UNIT UNDER CONSTRUCTION

ANNOUNCING the establishment of an oil-shale mining division in the Office of Synthetic Liquid Fuels, Dr. R. R. Sayers, director of the Bureau of Mines, said that E. D. Gardner, former regional engineer in charge of the Bureau's Central Experiment Station at Rolla, Mo., has been appointed chief of the new division.

The construction of a $1,500,000 oil-shale demonstration plant near Rifle, Colo., as part of the synthetic liquid fuels program of the U. S. Bureau of Mines is now getting under way. When completed by the end of this year, the plant will be operated jointly with a $340,000 oil-shale research and development laboratory at the University of Wyoming in Laramie which will have a laboratory personnel of about 70. Preliminary experiments are already under way at the laboratory.

The Rifle plant will serve as a proving ground for processes under development to convert the west's enormous reserves of oil shale into an auxiliary source of liquid fuels and lubricants. Supervising engineer of the project is Boyd Guthrie, University of Utah graduate chemical engineer, who was in charge of the Bureau's first oil-shale project at Rifle in 1928.

MORE GUAYULE PLANTS AUTHORIZED

ERECTION of four more guayule processing plants in California and harvest of all of the state's guayule rubber crop within two years to augment the country's dwindling supply of natural rubber has been ordered by federal authorities.

Firestone Tire & Rubber Co., under contracts with Rubber Reserve Corp., will build and operate two guayule processing plants at Bakersfield, in the southern part of the San Joaquin Valley, and two at Paterson, near Modesto. The plants are expected to cost between $300,000–$400,000 each. The two plants now in operation at Bakersfield and Salinas are turning out crude rubber at capacities of 5,000 lb. daily.

CARBIDE PLANT CONVERTED TO MINERAL WOOL PRODUCTION

INDEPENDENT INSULATIONS, INC., recently announced in Seattle, Wash., receipt of authorization to reconvert the DPC calcium carbide properties in Tacoma for production of mineral wool. Reconversion of the facilities, which cover about 13 acres and had a daily capacity of 40 tons carbide, will require from 90 to

Proved in Food Products! C. P. glycerine is a food itself, substantially equivalent in food value to carbohydrate. It has high sweetening power. No wonder it's used by so many manufacturers!

Proved in Cosmetics! C. P. glycerine's non-toxicity, emollient properties, resistance to evaporation, solvent power, and compatibility make it ideal for use in many cosmetics. Use glycerine!

Why Glycerine is a Superior Humectant: PERMANENCE

GLYCERINE as a humectant is permanent. Its permanence is a result of its low vapor pressure, its compatibility with hydrophilic materials, and its lack of tendency to "creep."

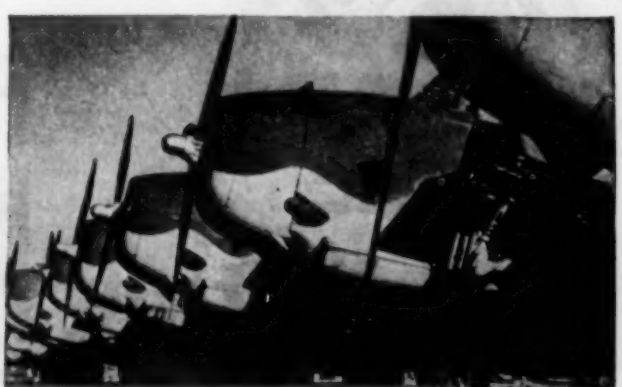
In the absence of a permanent humectant, glues dry out and are no longer adhesive and flexible; paper wrappings become dry and brittle; tobacco gives a less smooth and mellow smoke; cosmetics and dentifrices cake and crack; certain leather products become harsh and rough.

Does the adhesive on your scratch-pad or in a bookbinding become brittle? If so, the chances are that it has not been plasticized with glycerine but with some other material.

Glycerine is not only a superior humectant but a preferred plasticizer, solvent, carrier, preservative, lubricant, and key component in many essential products and materials. Its high viscosity, high solvent power, compatibility, non-toxicity, and other valuable properties can help you make superior products. Use glycerine, the time-tested ingredient, now freely available for the production of civilian goods. Glycerine Producers' Association, 295 Madison Avenue, New York 17, N. Y., Dept. E-8.

Proved in Medicines! C. P. glycerine, used as a solvent, carrier, and component of ointments, emollient solutions, plasters, and many other pharmaceuticals, is an old standby — proved safe.

Proved in Packaging! Because C. P. glycerine is non-toxic, it is used in the manufacture of transparent wrappings coming in contact with foods or food products. Use glycerine—and be sure!



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Tough Paints! Long-lasting paints for war equipment and for widespread industrial and home use have been made possible with alkyd resins, of which glycerine is an important raw material.

Common Sense Engineering on EVERLASTING VALVES!

EACH time an EVERLASTING valve is opened or closed, the disc rotates in constant contact with the valve seat . . . all parts move in a parallel plane . . . without any wedging action. That's unique, and yet—common-sense engineering!

THIS rotating movement of the disc across the seat—at each operation of the EVERLASTING valve—is a self-grinding, self-polishing, SELF-LAPPING action which maintains the perfect drop-tight seal when the valve is closed.

WEAR is effectively prevented because it is absolutely impossible for grit to lodge between the sealing surfaces—the disc never leaves the seat! Each sealing part being free, the EVERLASTING valve is self-compensating to expansion and contraction. Again, that's unique, and yet—common-sense engineering!

OTHER advantages, such as the quick, short-stroke quarter-turn lever operation . . . the straight-through flow . . . and the impossibility of clogging, sticking or binding . . . have made EVERLASTING the favorite valve with engineers for 40 years.

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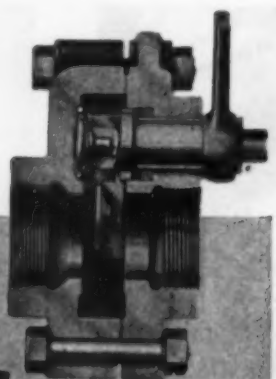

Everlasting Valves

FOR EVERLASTING PROTECTION

120 days. The $1,000,000 plant, formerly operated by Pacific Carbide & Alloys Co., has extensive factory, laboratory, warehouse and transportation facilities.

Independent Insulations, a Washington-owned firm, is headed by Henry Hainert, president, John B. Bridgeford, executive director and William T. Dunne, secretary-treasurer and founder. It will produce mineral wool from slags derived from Tacoma smelters for insulation used in construction fields as well as in refrigeration.

ALUMINUM-TREATING PROCESS DEVELOPED IN NORTHWEST

A NEW process for strengthening aluminum by heat treatment, devised over a period of six months by several Pacific Northwest firms, has been put to work for the first time by the Oregon Brass Works at Portland, it was announced recently. The process differs with different types of castings, their alloys and effects desired. Generally it involves heating the aluminum by gas, frequently almost to its melting point of 1,200 deg. F., and cooling it by water or blasts of air. Though virtually still in experimental stages the process, after a month's use at Oregon Brass Works, had been applied to aluminum outboard motor sockets, nesting buffers for pontoons and for aluminum provision covers for life rafts.

OPERATION OF THE BMI PLANT SUBDIVIDED

WITHDRAWAL of Basic Magnesium, Inc., from management and operation of the $160,000,000 DPC magnesium plant near Las Vegas, Nev., was announced recently. Anaconda Copper Mining Co. has managed the plant since October, 1942. Ownership will be retained by DPC.

J. M. Montgomery & Co. of Los Angeles, Stauffer Chemical Co. of San Francisco, Western Electro Chemical Co., and Rheem Manufacturing Co., both of Los Angeles, are taking over various operations of the works. J. M. Montgomery & Co., design and construction engineers, has a five-year contract to operate the BMI water and power facilities for DPC, as well as to provide cafeteria and other services.

Stauffer Chemical Co., under a five-year lease from DPC, took over the electrolytic caustic soda units and boiler plants. Stauffer will manufacture caustic soda for shipment to southern California and liquid chlorine for shipment to southern California and the east. Original capacity of the BMI plant was some 225 tons of chlorine daily from 900 Hooker S cells of 7,500 amp. capacity each. C. P. Donohoe, who was affiliated with BMI and Anaconda, is plant superintendent for Stauffer.

Western Electro Chemical Co., under another DPC lease, has already taken over a large magnesium metal unit and adjacent buildings for the manufacture of potassium perchlorate to be used in Navy plane jet take-off units. This plant is expected to be in operation by late August. Bechtel-McCone Corp. of Los Angeles is installing new equipment which is expected to cost about $5,500,000. The potassium perchlorate is to be

Production Problems YOU CAN Forget WITH Veelos

A V-BELT that requires constant, time-wasting maintenance is a production handicap. You need NOT put up with it . . . when you can replace with Veelos—the adjustable V-belt. Then—you can *forget* these power transmission worries:

1. Lengthy Machine Shutdowns to Permit Belt Replacement: With Veelos in rolls, V-belts can be replaced in a few minutes . . . maintaining machine production . . . reducing machine downtime.

2. Belt Slippage: Veelos link construction provides quick, easy tension adjustment to end slippage . . . keeps machinery running at full speed and productivity.

3. Uneven Delivery of Power on Multiple Drives: Easy adjustment of Veelos assures that each strand of a multiple belt will carry its exact share of the load. All strands constantly work together, *delivering full power.*

4. Bulky, Expensive Belt Inventories: Veelos lowers investment in V-belt stock and space . . . rolls of common sizes provide belts of any desired length . . . simplify stock records.

There's a book waiting for you that's a guide to easier belt maintenance and installation. It's the *free 8-page illustrated manual* giving Veelos applications, construction detail, installation directions and engineering data. *Write for your copy today.*

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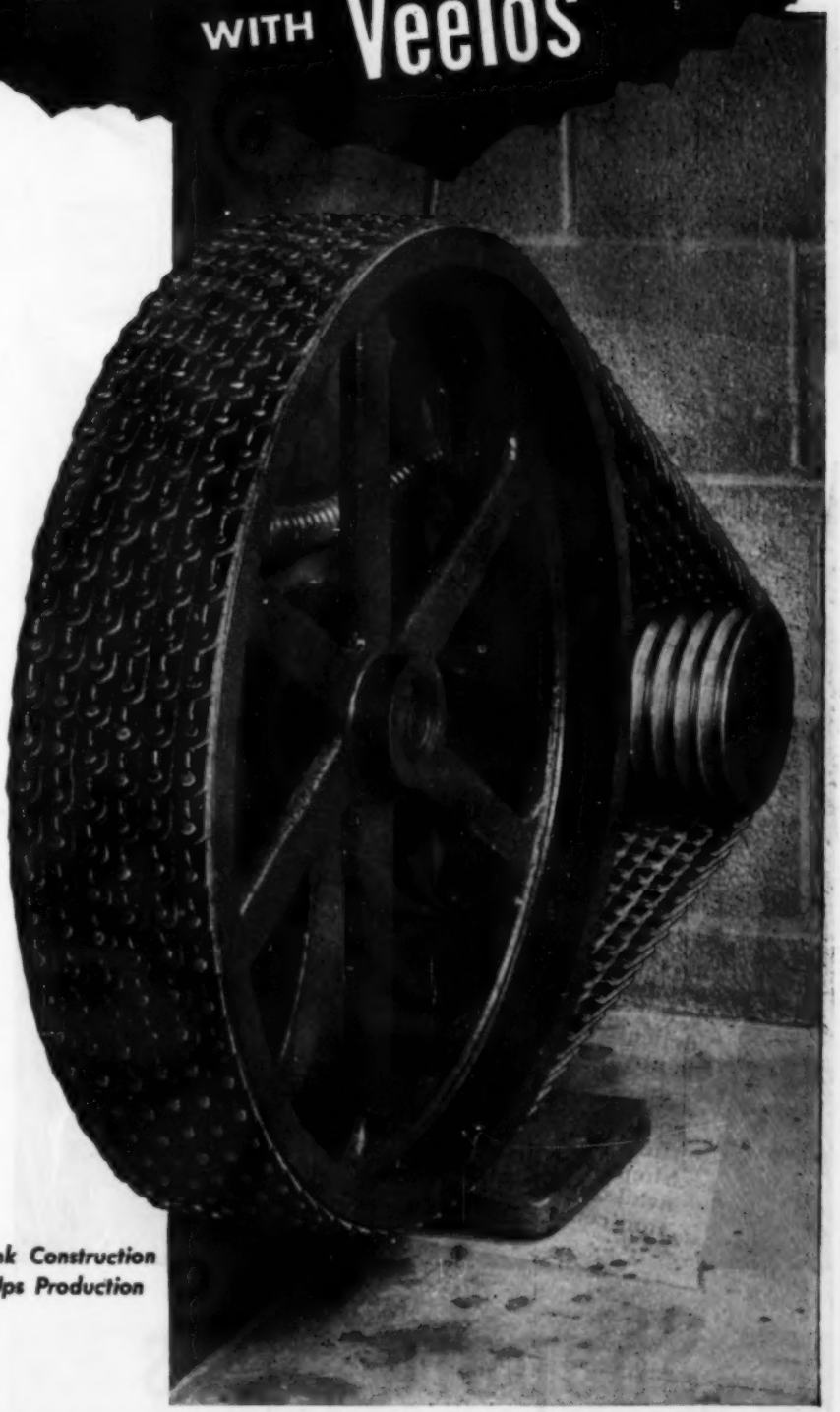
Get the "hang" of it, and you'll couple and uncouple Veelos as easily as you button your shirt. This unique, link construction is the big reason why production goes up when Veelos goes on.



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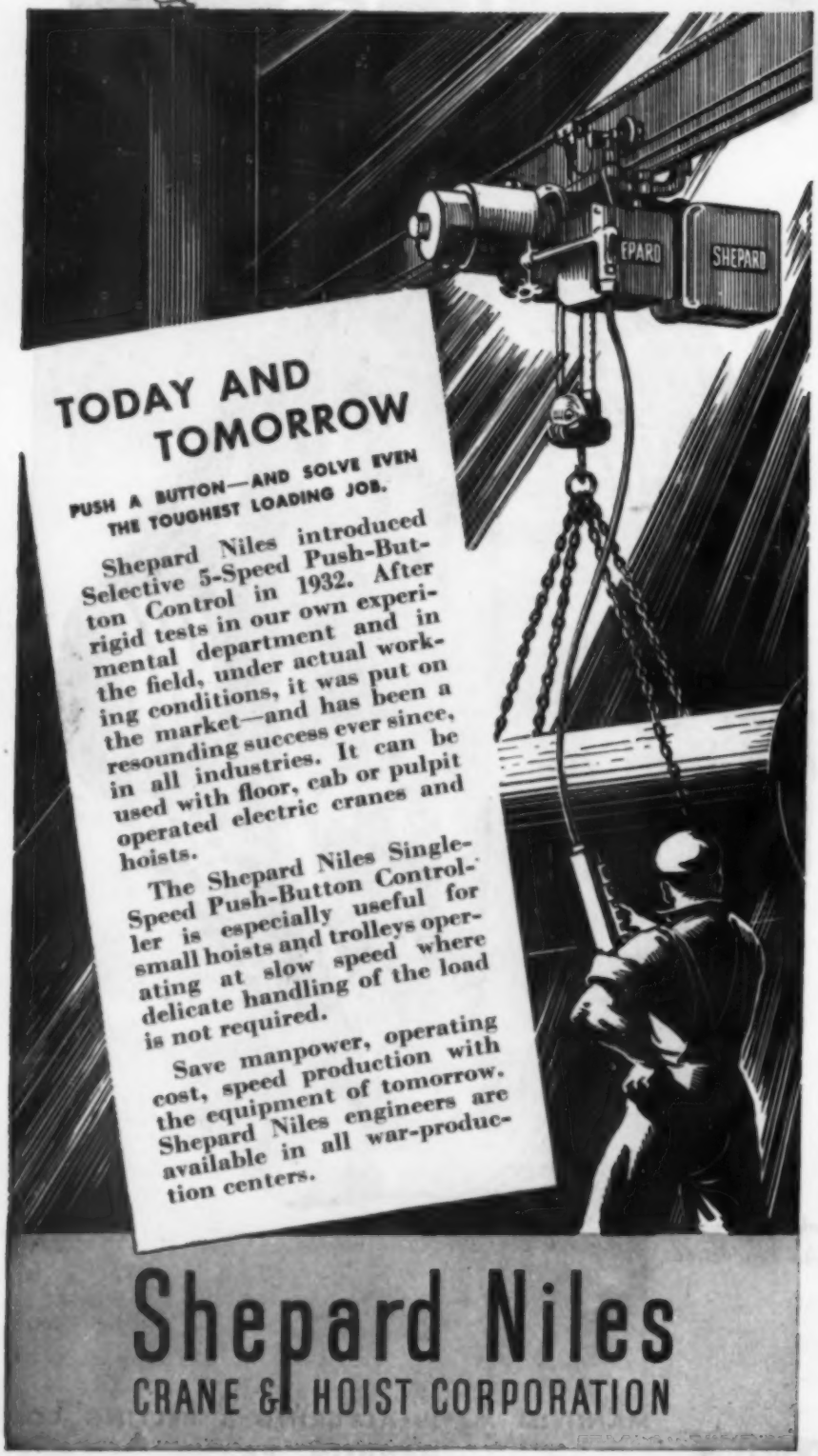

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Save manpower, operating cost, speed production with the equipment of tomorrow. Shepard Niles engineers are available in all war-production centers.

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made by a new process now in use in the company's Los Angeles plant. J. Ray Coulter, BMI production manager, is now Western Electro's project manager at the Nevada plant.

Several other BMI metal units, idle since magnesium production was halted several months ago, are being used as warehouses. Rheem Manufacturing Co. of Los Angeles has already taken over some 200,000 sq. ft. of space for the production of Navy 5-in. rockets and Army 81-mm. trench mortars. C. R. Collord is plant manager for Rheem.

CALIFORNIA SALINE OUTPUT LARGEST ON RECORD

During 1944 California produced the largest annual output of sodium salts, including soda ash, trona and salt cake, ever reported for the state, with 299,574 tons being shipped as compared to 260,590 tons in 1943. Borate materials also showed a marked gain, with a 1944 output of 276,398 tons or 26,875 tons over 1943. Production of salt in 1944 was 769,873 net tons—the largest annual yield ever reported in the state— as against the 1943 output of 631,776 tons.

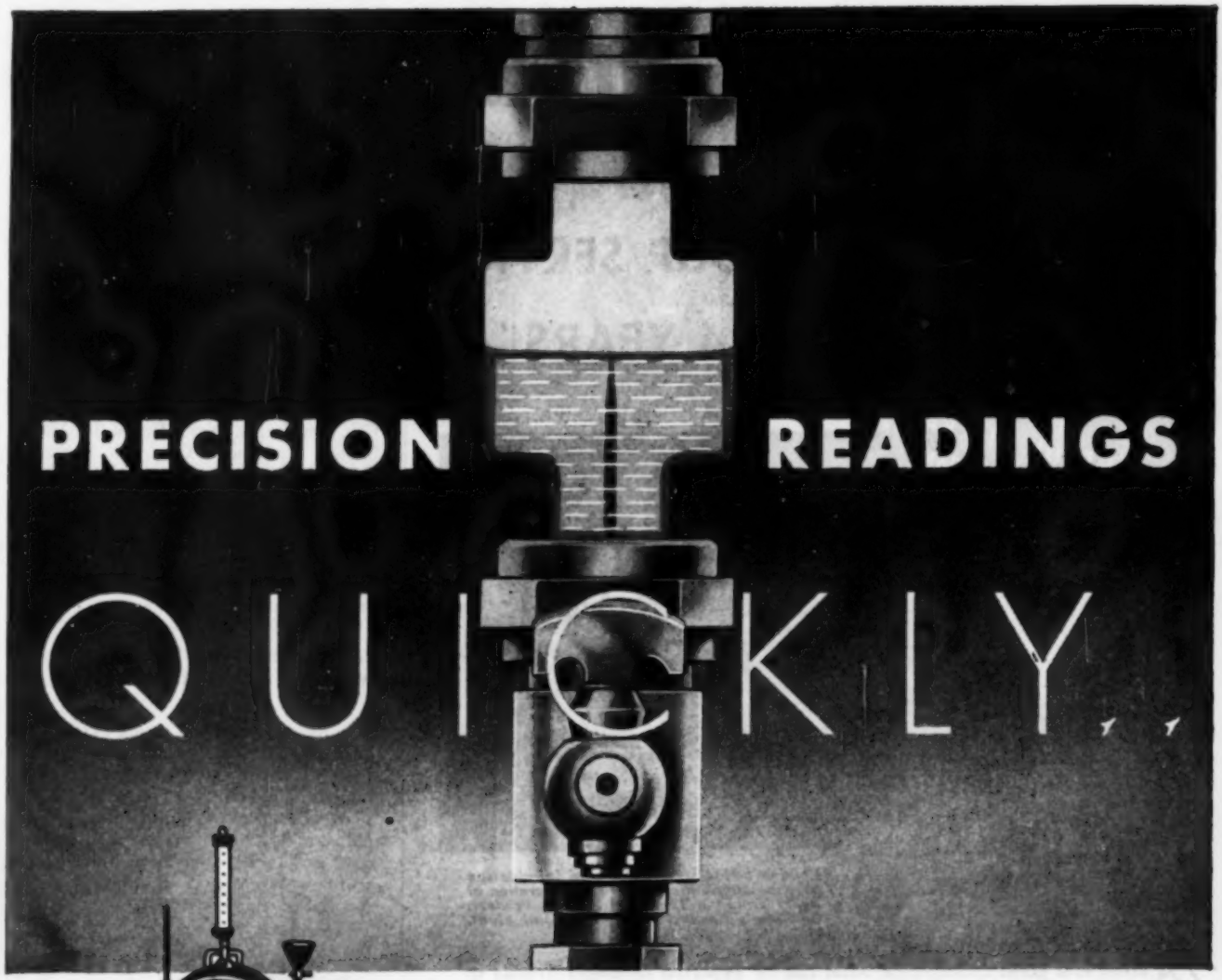
California producers of borates, soda ash, trona, salt cake and salt during 1944 have been listed as follows by the California Division of Mines:

Producer	Plant	Products
American Potash & Chemical Co.	Trona	Borates, soda ash, salt cake
American Salt Co.	Mt. Eden	Salt
California Rock Salt Co.	Amboy	Salt
Desert Chemical Co.	Amboy	Salt cake, salt
Imperial Salt Co.	Calipatria	Salt
Leslie Salt Co.	Newark, Mt. Eden	Salt
Long Beach Salt Co.	Saltdale, Long Beach	Salt
Monterey Bay Salt Works.	Moss Landing.	Salt
Natural Soda Products Co.	Keeler	Soda ash, trona
Oliver Bros. Salt Co.	Mt. Eden	Salt
Pacific Coast Borax Co.	Kramer	Borates
Pittsburgh Plate Glass Co., Columbia Chemicals Div.	Bartlett	Borates, soda ash, trona
The Irvine Co.	Justin	Salt
United States Borax Co.	Death Valley.	Borates
West End Chemical Co.	West End.	Borates, soda ash, salt cake
Western Salt Co.	San Diego	Salt

WESTERN LIGHT METALS POLICY FORMULATED

In a move to insure an adequate postwar supply of cheap aluminum and magnesium for industry, the Western States Council, a federation of Chambers of Commerce in the 11 western states formed late last year to take united stands on matters affecting the area west of the Rocky Mountains, held its initial Light Metals Conference in Seattle, June 21-23. Attended by nearly 300 representatives of the light metals industries, the conference was devoted to down-to-earth technical and economic discussions on the complete integration of the aluminum and magnesium industries of the west from alumina reduction to complete extrusion, forging and fabricating plants.

A permanent action committee headed by D. K. MacDonald, Seattle business leader, was formed of 15 interested persons not directly in the industry. It is now the



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CASE HISTORY OF THE THOMPSON AIRCRAFT PRODUCTS COMPANY

Routine periodic inspection and lubrication pays substantial dividends in the operation of Baker Trucks at Thompson Aircraft Products Company's mammoth new Cleveland plant.

Here is a good example of what can be expected of Baker Trucks in the way of *continuous operation*, when properly cared for. According to N. J. Shibley, Superintendent of Building and Property Maintenance at Thompson, their Baker Crane Truck and ten Baker Fork Trucks are as good as new after serving three shifts per day for nearly four years —the equivalent of 12 years of normal service. No truck has been overhauled, there have been only a few minor mechanical failures, and maintenance has been almost negligible.

Actual time out of service averages less than ½ hour per day, per truck, divided as follows:

Daily check of Hydraulic System	**5 min.**
Battery changes (2 min. each shift)	**6 min.**
Weekly lubrication (45 min.)—per day . . .	**7 min.**
Other maintenance (Tires, brakes, inspection and adjustment of electrical controls, etc.) 45 hours per month for 11 trucks—per day	**10 min.**
Total .	**28 min.**

Except for the above and for a ten minute period between shifts when trucks are idle, they have been giving "round-the-clock" service for four years and, says Mr. Shibley, "if we continue to take good care of them, they should last indefinitely." That's *Continuity!*

To help you keep your Baker trucks operating continuously and to insure long life, write for "Industrial Truck Care Pays You Dividends."

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Baker INDUSTRIAL TRUCKS

task of this committee to develop means of complete integration of the industry by private capital through investigating postwar markets, developing favorable freight rates for finished products, negotiating for acquisition of DPC properties by competent operators and other means. Biggest potential threat to postwar survival of the light metals industry in the Pacific Northwest is Canada's gigantic Shipshaw project, it was generally agreed.

Among the other members of the integration committee are John Beall, president, Beall Pipe & Tank Co., Portland; Benjamin Benovski, New Mexico School of Mines, Socorro, N. M.; James L. Bradford, general manager, Magnesium Casting Co., Las Vegas, Nev.; Ernest L. Mathy, Victor Equipment Co., San Francisco; Tom Moffet, Hooker Electrochemical Co., Tacoma; Bryant Myer, general manager, Kenney Aluminum Co., Los Angeles; Dr. Delworth Walker, University of Utah, Salt Lake City. General secretary of the committee is James E. Louttit, head of the Seattle Chamber of Commerce.

PRODUCTION OF WESTERN WOOD PULP INCREASED

TOTAL production of all grades of wood pulp for the west coast region during 1944 increased some 8 percent over that for 1943 to reach 1,664,531 tons. Total sulphate production increased by almost 27 percent to reach 422,519 tons. Wood pulp production by types for the west coast during 1944 has been broken down as follows by the U. S. Pulp Producers Association (in short tons):

	1944	1943
Bleached sulphite	558,067	550,078
Unbleached sulphite	349,733	345,860
Total sulphite	907,800	895,938
Bleached sulphate	55,817	27,868
Unbleached sulphate	366,702	305,272
Total sulphate	422,519	333,140
Groundwood	259,922	245,863
Semi-chemical	54,290	37,790
Soda	*	*
Total all grades	1,644,531	1,521,531

* Omitted to avoid disclosing one firm's production.

HARSHAW EXPANDS ANTIMONY CHEMICALS PLANT

CONSTRUCTION work has just been completed on a new $350,000 antimony smelter and oxide plant at the El Segundo, Calif., works of Harshaw Chemical Co. Construction has been handled by Southwestern Engineering Co. of Los Angeles. H. B. Menardi, manager of the local division of Harshaw, has been in direct charge of the project. Already a producer of tungstic acid, the El Segundo plant now has added materially to Southern California's output of refined metal products.

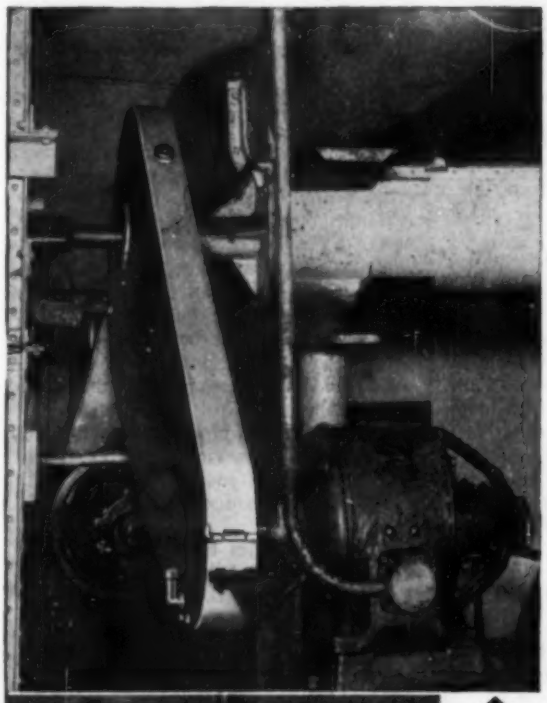
ALCOA PLANS TO REMAIN IN PACIFIC NORTHWEST

INTENTIONS of the Aluminum Co. of America to continue operations in the Pacific Northwest are evident in expansion of the Vancouver Wash., plant, Arthur V. Davis, chairman of the board of Alcoa,

MODERNIZING POWER TRANSMISSION WITH *Silverstreak*

SILENT CHAIN DRIVES

After Eight Years of Continuous Operation These Drives Are Still As Efficient As When Installed



There are seven screw conveyor drives similar to these two.

Four silent chain drives operate the malting drums. Note Link-Belt roller chain second reduction.

An important part of the modernization program put in effect in 1937 in a Wisconsin malting plant, was the installation of Link-Belt Silverstreak silent chain drives. Wherever one looks in this plant, he sees not one, but several of the distinctive casings, enclosing quiet, efficient chains, driving elevators, screw conveyors and malting drums. A few of these drives are illustrated. The efficiency of Silverstreak silent chain drives gives precise control to the quality of the product. Their economy, (low first cost, negligible upkeep and long trouble-free service) is reflected in the profitable operation of the plant.

With conversion and modernizing in your immediate or future plans, be sure to give Link-Belt Silverstreak silent chain drives full consideration.

LINK-BELT COMPANY

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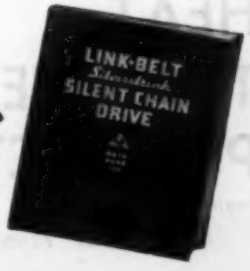
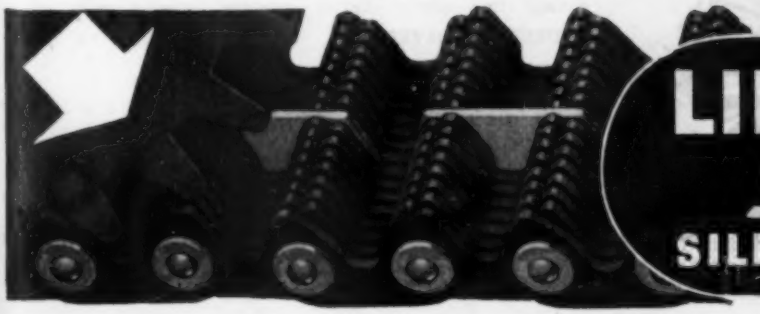
Elevator drive using Silverstreak silent chain for first and second reduction.



Send for Silent Chain Data Book No. 125 for full engineering and application data.



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SILENT CHAIN DRIVE

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A Shipment of Main Condensers Leaving Our Carbondale Plant

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recently said while inspecting the company's plants in the Portland, Ore., area. Wholly owned and developed by company funds, the Vancouver plant has expanded nearly six fold since it opened in 1940, then designed to produce 15,000 tons of aluminum per year. Location of an alumina plant which Alcoa has announced it may build in the Northwest has not been divulged, though engineers are conducting test operations on alumina-bearing ores recently discovered in the Hillsboro, Ore., vicinity.

NEW HIGH-OCTANE PLANT PLANNED FOR TORRANCE

General Petroleum Corp., Los Angeles, has recently announced plans for construction of a $3,000,000 high-octane gasoline production plant at Torrance, Calif. Plans include a 196-ft. structure to house the project, which would make use of a new refining process known as "delayed recycle coking." The new unit would add 13,000–15,000 bbl. of aviation gasoline components daily to General Petroleum's present production at Torrance.

NEW PHTHALIC ANHYDRIDE UNIT BEGINS OPERATIONS

Representing the first phthalic anhydride unit to be located in the west, the new plant of Oronite Chemical Co. at Richmond, Calif., is expected to go into initial operations during August. The plant, unique in its use of o-xylol as raw material for this purpose, will be able to turn out some 3,500 tons annually of phthalic anhydride for alkyd resins, plasticizers, insectifuges and other products for western markets. Production of this basic organic chemical from petroleum raw materials will be a major step toward more complete integration of the chemical and process industries of the region.

WINERY CHEMICAL BYPRODUCT RECOVERY PROGRESSES

Recovery of tartrate chemicals and other byproducts from California wineries continued to make gains over previous years, it was recently revealed. This byproduct chemicals industry, largely developed within the past four years, now produces considerable tartrates as calcium tartrate, as dried lees and as argols. Also being recovered are fertilizer-grade pomace, raisin and grapeseed oil for raisin packers and pharmaceutical uses, enocianina or grape coloring for production of essences and colored sirups, vinegar, fertilizer- and feed-grade raisin seeds and stems. Tannin has recently been discussed as a potential byproduct.

Recent estimates from Washington on California winery byproducts recovery for 1944 are as follows:

	Amount	Approx. Value
Calcium tartrate, lb.	600,000*	$276,000
Lees and argols (pot. bitartrate), lb.	675,000**	250,000
Raisin seed oil, gal.	50,000	125,000
Seeds and stem mixtures, tons	5,000	100,000
Enocianina, gal.	10,000	50,000
Vinegar, 22 gal. of wine diverted	98,000	.....

* Calculated on the basis of pure tartaric acid. ** Calculated on the basis of potassium bitartrate.

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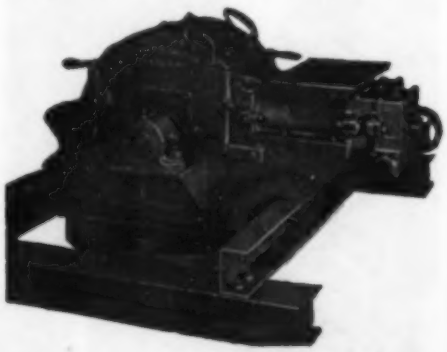
GRUENDLER "SUPER MASTER" PULVERIZER



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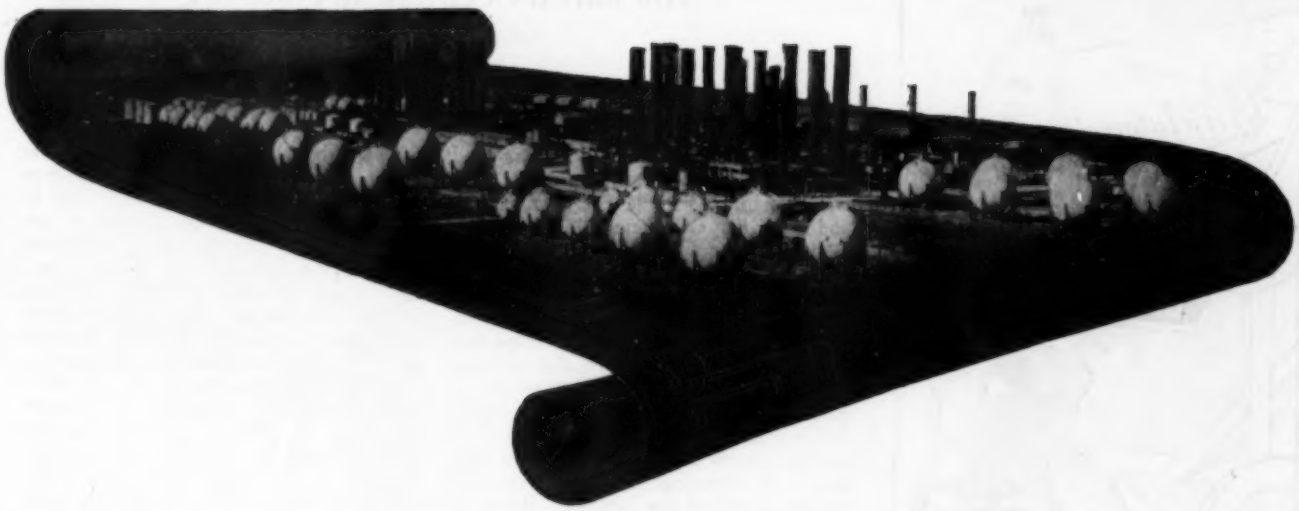

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NEWS FROM ABROAD

ESSENTIAL CIVILIAN NEEDS PROVIDE NEW PRIORITIES FOR BRITAIN'S CHEMICAL INDUSTRY

Special Correspondence

TRANSFORMATION of the British economy from war to peace has begun. The war against Japan will make great demands on industrial production, but housing and essential civilian needs are now to be given equal priority with the Far Eastern war. Industries like the chemical trades which work for a large variety of different purposes will remain subject to a high degree of official control and supervision. Men in age between 18 and 50 and women between 18 and 40 can still be directed into specific types of employment, and such specialists as chemists, metallurgists, physicists, pharmacists and engineers remain under full wartime control because there is a serious scarcity of manpower in these vocations. A beginning has been made with the de-control of raw materials. Buyers of copper and zinc still need a license but will obtain it without restriction as to the purpose for which the metal is to be used, and licenses are no longer required for formaldehyde, phenol, cresol and urea molding powders and synthetic resins.

There are few pointers yet to the economic policy which the British Government will pursue in the transition period. A spirit of venture and experiment is called for to cope with urgent problems, and the chemical industry is well placed for giving help in their solution. A first order for 50,000 aluminum houses has been placed with light metal manufacturers to help to mitigate the housing shortage, and other instances of expanded wartime industries being utilized for peacetime needs can be quoted. Schemes for the disposal of surplus stocks are being drawn up, and trade associations cooperate in the return to trading through ordinary commercial channels.

The transition to a free economy, however, must necessarily be slow, and the priority system is bound to stay for considerable time though more and more civilian goods will be included in the priority range. A great amount of labor has been released for textiles and domestic equipment, two categories of goods which suffered from serious shortages in the recent past.

The wartime record of British chemical manufacturers fully justifies the expectation that the industry will play a successful part in the reconstruction of the country. Imperial Chemical Industries Ltd., with a peacetime establishment of 70,000 employees, the biggest of British manufacturing firms, has just told the story of its wartime activities. The Billingham ammonium sulphate plant produced some 220,000 tons before the war; by the end of 1943 its out-

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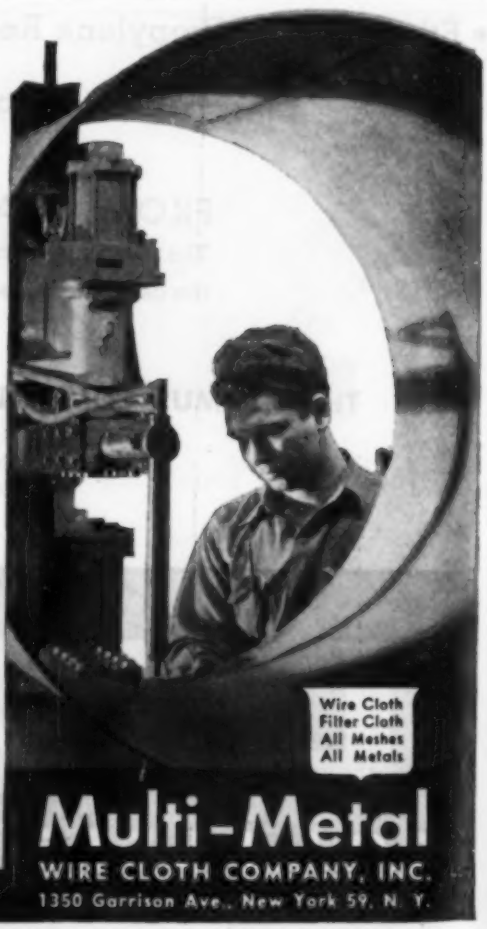

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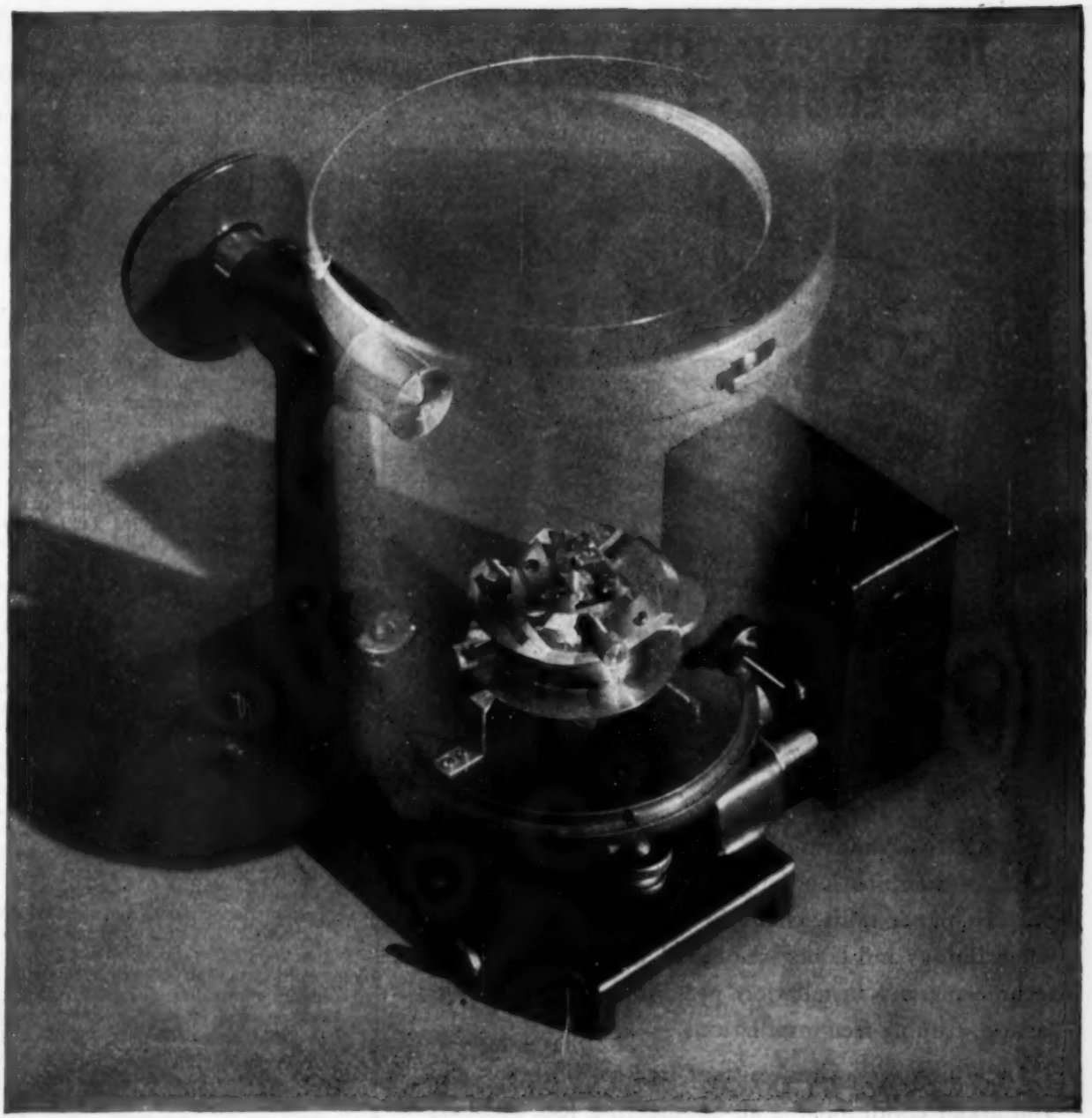

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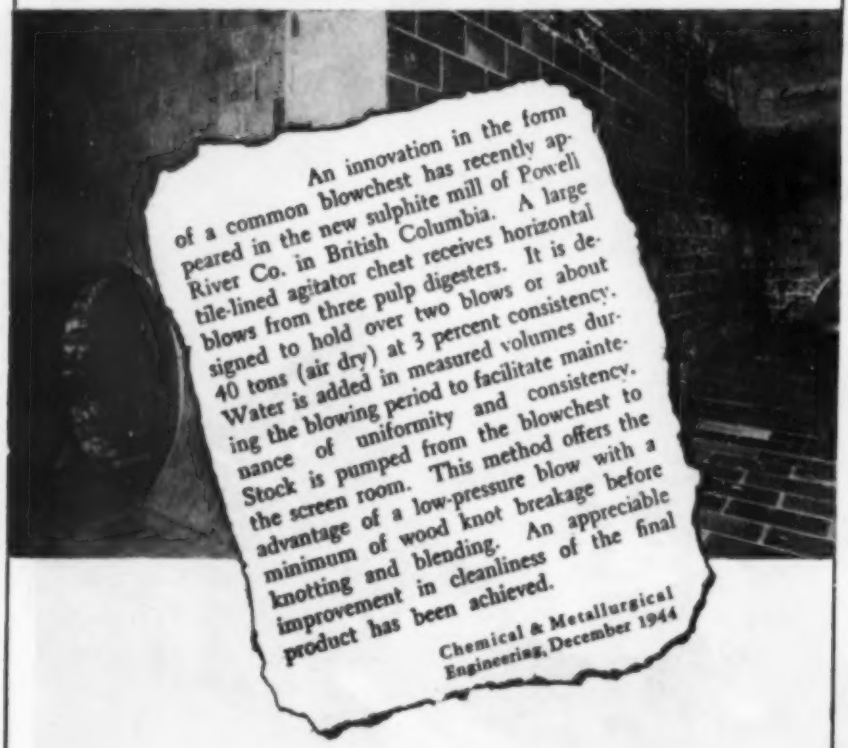
THE "INNOVATION" WAS STEBBINS LINED


An innovation in the form of a common blowchest has recently appeared in the new sulphite mill of Powell River Co. in British Columbia. A large tile-lined agitator chest receives horizontal blows from three pulp digesters. It is designed to hold over two blows or about 40 tons (air dry) at 3 percent consistency. Water is added in measured volumes during the blowing period to facilitate maintenance of uniformity and consistency. Stock is pumped from the blowchest to the screen room. This method offers the advantage of a low-pressure blow with a minimum of wood knot breakage before knotting and blending. An appreciable improvement in cleanliness of the final product has been achieved.
Chemical & Metallurgical Engineering, December 1944

MAKING "innovations" work has been a large part of Stebbins job for sixty-one years. Whether in pulp or paper mills, chemical or metallurgical plants when linings and tanks are needed, Stebbins engineers, technicians and installation personnel, produce long-lasting, trouble-free installations.

Designing corrosion-resistant linings, both for acid and alkali conditions, is an engineering job. Stebbins experience in designing, installing and servicing linings and tile tanks is long in years and wide in the types of installations made. This experience extends not only throughout the North American continent, but to Central and South America and the Orient.

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Call in Stebbins whenever you have a lining or tile tank problem.

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put had risen to 385,000 tons, which was still far short of the demand so that an entirely new factory for 265,000 tons annually was built at Brudhoe, County Durham, to be operated for the Ministry of Supply. The annual output of "nitro-chalk" and compound fertilizers was stepped up from 175,000 tons in 1939 to 285,000 tons in 1944.

EXPLOSIVES PLANTS

The huge demand for explosives was met by adding to the I.C.I. plant and by building and operating seven new explosives factories as agents for the government. Since 1939 almost 440,000 tons of explosives have been made in these factories, besides hundreds of millions of detonators, fuses and other accessories, including the filling for over 90,000,000 incendiary bombs. In addition I.C.I. was responsible for building 17 major ammunition factories and several smaller ones and for operating 36 such factories.

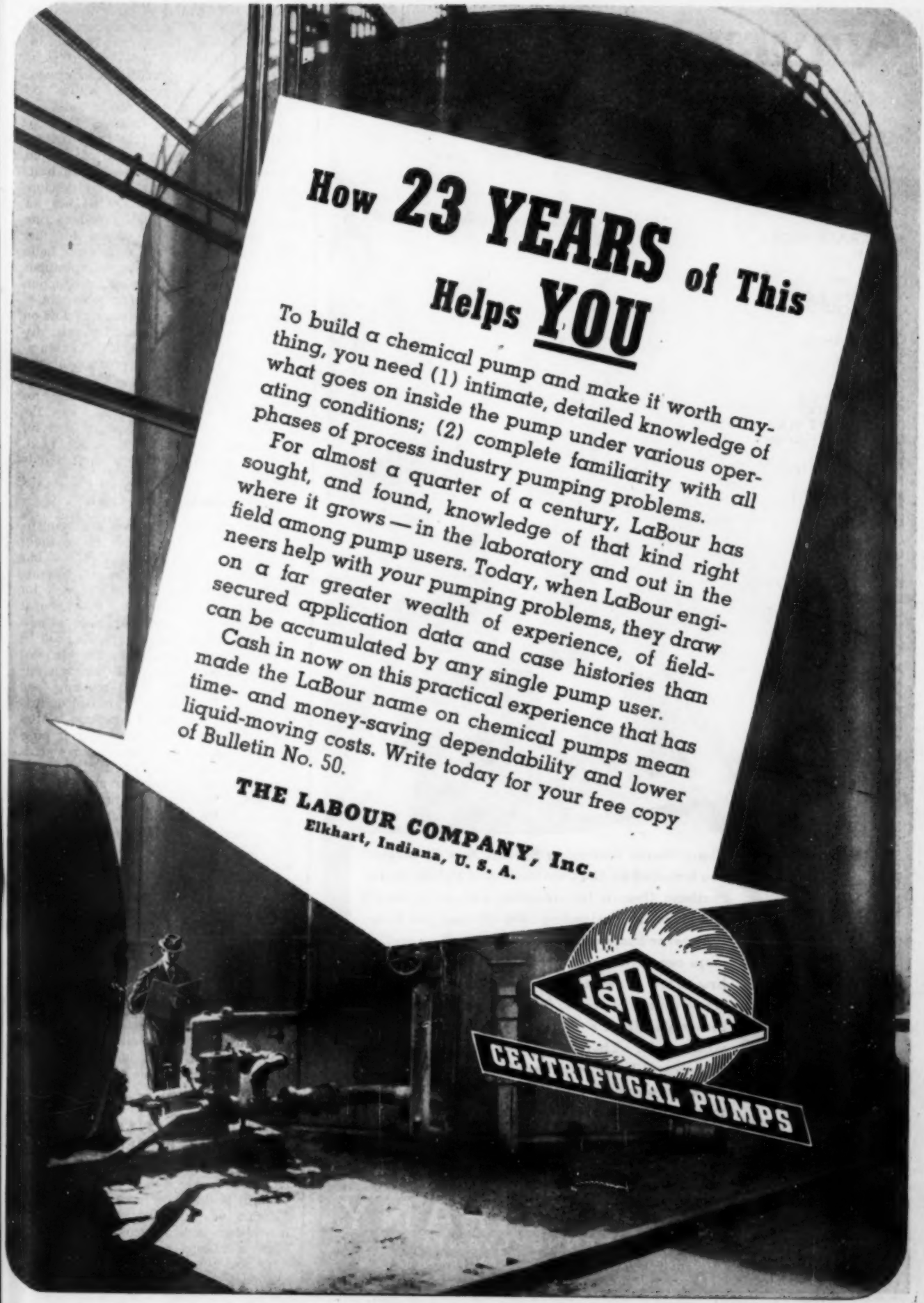
These new small arms ammunition factories, together with the I.C.I. plant at Witton, produced a substantial percentage of Britain's ammunition requirements. By the end of 1944 they had turned out over 3,500 million rounds. The metal division manufactured more than 67 different types of filled S.A.A. and other cartridges for special purposes. The output of the company's non-ferrous metal factories rose by more than half above the prewar level; many of them worked at double their normal capacity. When production was at its peak, the finished metal production of the Witton plant alone averaged over 3,000 tons a week throughout the year.

An entirely new I.C.I. factory was built to manufacture metal fuel tanks, and non-metallic bullet-proof aircraft fuel tanks were also made. The output of "Perspex," the non-splintering glazing material used almost universally for British aircraft, increased ten times in the company's factories, and in addition two plants with a combined capacity greater than the I.C.I.'s were built and are being operated for the government. A plant for making polyvinyl chloride, chiefly to replace rubber in flexible cable coverings, was created early in the war, and when Malaya fell a much larger one was built for the government. I.C.I. also installed equipment to fabricate the cable compounds.

The first "Polythene" (polymerized ethylene) production unit came into operation early in September 1939. A decision to double the plant was taken at once, in 1942 it was possible to treble the output of 1941, and in 1943 to double that of 1942. This expansion program was of course carried out to meet specific war requirements, but the output capacity thus created will stand the chemical industry in good stead for meeting peacetime needs.

Reference was made to the factories built by I.C.I. for the government and run by the company as agents for certain Ministries. Such government-owned plants will presumably in the end be transferred to private ownership, as has already been done in one or two instances. The urgent needs of peacetime, on the other hand, are likely to call for further cooperation between the State as principal and private firms as agents.

Research and development, plant con-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GRITS
IRON OXIDE
KAOLIN
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LIME (pebble)
LIME (pulverized)
LIMESTONE
MALT
MEALS
MIDDLINGS
OATS
PYROBOR
RESIN (synthetic)
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SALT
SALT CAKE
SAND
SAW DUST
SHALE
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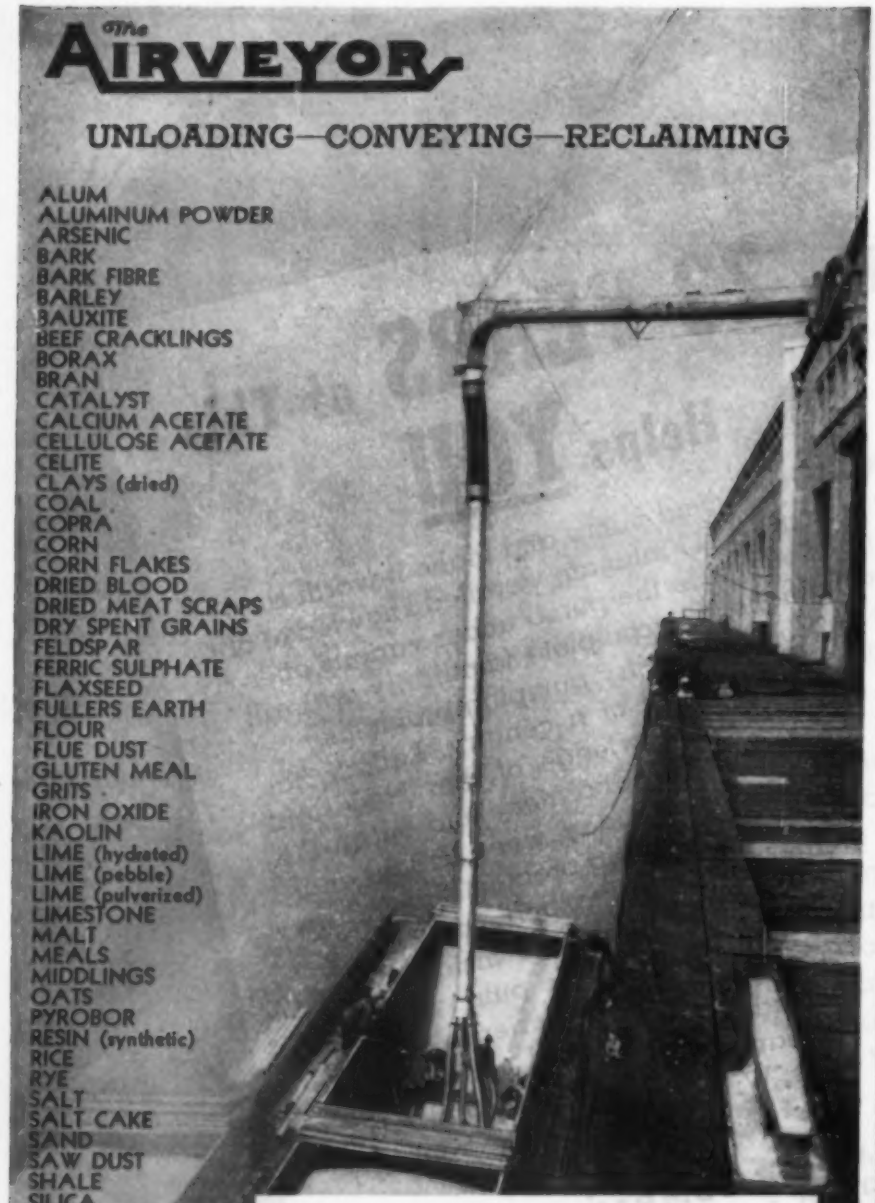

The Airveyor Conveying System here illustrated was installed by the Commission of Public Docks, Portland, Oregon, for unloading grain from barges and ships . . . unloading rate 120 tons per hour.

Airveyor Systems are built for small as well as large capacities, commercial installations handling as low as two tons per hour are in operation. If you unload or convey fine, crushed and granular materials, there's an Airveyor System to suit your needs. There's a possibility that such a system will lower your handling costs. Why not let our engineers look into your problem . . . they're doing it every day and chances are they can help you.

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struction and training of labor formed an important part of the war contribution of the British chemical industry. Help in insuring best results of chemical fertilizers; organization of a national silage campaign; utilization of mining experience with plastic explosives for such new missiles as sticky bombs and the "Flying Dustbin"; development of the P.I.A.T. (anti-tank infantry projector); design of a range of delayed action detonators; production of soup-heating cartridges for self-heating tins; development of mass-production techniques for tracer and incendiary bullets; manufacture of self-sealing rubber coverings for fuel tanks; work in the field of low-loss radio ceramics; new anti-fouling compositions and luminous paints; large-scale production of "Mepacrine," the quinine substitute of which over 100 tons, equivalent to close on 2 billion tablets, were made last year; discovery of the new insecticide "Gammexane," now in small-scale production; and the weed-killer "Methoxone"; cooperation in the erection of a new refinery for highest-grade aviation gasoline; and development of "Victane" aircraft fuel for flying-bomb hunters—all these are I.C.I. achievements, and yet the account is only fragmentary.

POSTWAR OUTLOOK

These and other wartime achievements of Britain's chemical industry will no doubt be turned to good use in peacetime, but the outlook for the future is still obscure. Not only does the industry still wait for an elucidation of government policy, but it has become clear that the price of raw materials, and of coal in particular, will be so much higher than before the war that British manufacturers will be seriously handicapped. Plants need repairing and improving, labor must be retrained, new markets call for special attention. After nearly six years of war the restocking progress will demand great financial resources, while in wartime surplus funds were absorbed by special taxation and Treasury borrowing. The concentration on war requirements has made research and development somewhat lop-sided, and the industry still suffers from a shortage of skilled personnel.

But such difficulties, however irksome, cannot suppress the confident and vigorous spirit which wartime achievements have engendered. At the same time there is growing realization of the need for cooperation between managers and employees, between suppliers and their customers, between private firms and public authorities, and also between competitors. Wartime concentration of production may find its counterpart in peacetime mergers, even though the small and independent firms have proved their value no less than the big combines.

TARTARIC AND CITRIC ACID PRODUCTION IN SICILY

SHORTAGE of raw materials continues to hold down production of tartaric and citric acids in Sicily. The tartaric acid plant at Palermo is producing only about 100 metric tons of acid a month. The same plant is turning out about 150 tons of citric acid a month as against a capacity of 600 tons.

WEATHER CAN'T AFFECT THE EFFICIENCY of this outdoor insulation

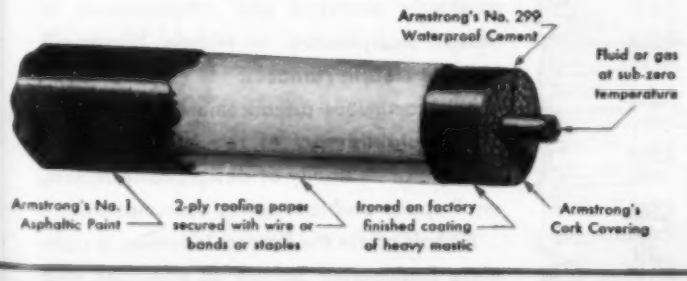
LOW-TEMPERATURE equipment that must be located outdoors not only requires efficient insulation but the insulation must readily take protective finishes to withstand all kinds of severe weather conditions. And finishes must withstand expansion and contraction as well as weather conditions. Armstrong, with forty years' experience in this type of work, has developed not only efficient insulations but also specifications and durable finishes to safeguard these insulations outdoors.

Shown here are outdoor vessels and lines insulated by Armstrong's Contract Service for the Ugite Corp., Chester, Pa. To maintain temperatures from zero to 115° below zero, Armstrong's Brine Thickness Cork Covering, Armstrong's Cork Lagging, and Corkboard, 6" and 8" thick, were used.

To weatherproof this insulation, it was finished with Armstrong's Insulmastic, a fire-resistant clay emulsion of asphalt with asbestos fibers, special fillers, and water. It dries to a hard black finish that does not crack, blister, or sag. It seals out water, air, moisture, and fumes.

For every type of service, indoors and out, Armstrong manufactures and supplies specialized insulation finishes such as asphalt cut-backs with solvents, clay emulsions, and special paints. For full information about Armstrong finishes and the Contract Service, write to Armstrong Cork Company, Building Materials Division, 3307 Concord Street, Lancaster, Penna.

HOW LOW-TEMPERATURE LINES ARE FULLY PROTECTED — OUTDOORS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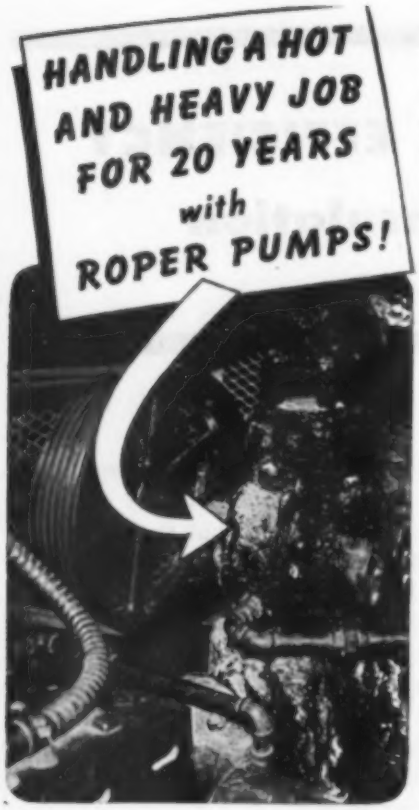

The job of pumping hot and heavy liquids is no pushover . . . it's about as tough as they come . . . yet the Roper illustrated above has been in continuous service for over 20 years. . . This pump, and 7 others like it, are pumping asphalt at 500° temperature and hot oil at 600°, 24 hours a day, 6 or 7 days a week at the Weaver-Wall Company plant, Cleveland, Ohio. Their report is, "Service amazingly satisfactory at remarkably low maintenance cost".

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ROPER Rotary Pumps

SOUTH AFRICA EXPANDS PRODUCTION OF CHEMICALS AND CHEMICAL ENGINEERING EQUIPMENT

Special Correspondence

After successful production of food yeast on the pilot scale at Durban in 1944, the Industrial Development Corp. of South Africa arranged for the erection of a semi-commercial plant to be located in the premises of the Natal Cane By-Products, Ltd., Merebank, Durban, in anticipation of the sugar industry's cooperation in further development work. Negotiations with the sugar industry resulted in the formation of a company called the Food Yeast Development Co., Ltd., with a capital of £20,000 which has been subscribed equally by the Industrial Development Corp. and the S. A. Sugar Association. The objects of the company are to carry the process through the semi-commercial stage, explore markets, determine costs of production and formulate plans for full-scale commercial production.

The plant for semi-commercial production has been fabricated, the stainless steel sheet and tubing required having been made in South Africa. Food yeast is manufactured from molasses. Although it contains about 50 percent protein, its chief value lies in its high content of the B group of vitamins. The potentiality of the project can be gaged from that fact that an output of 20,000 tons will be possible in an average year without interfering with existing commercial use of molasses apart from that exported.

South African structural and mechanical engineers have for some years been manufacturing equipment for chemical processes. Equipment has been made for food processing concerns; settling tanks and components of filters, thickeners and agitators for the mining industry; gasometers for the gas industry; large storage tanks, as well as pressure and vacuum vessels used in the cracking process for the mineral oil industry; bone and hide digesters for glue extraction; and evaporators of particularly large capacity for the recently established chrome salt industry, gelatine manufacture and the purification of glycerine. Soap-making pans, crutchers and other soap-making equipment also have been made.

Other products are neutralizers and deodorizers, kettles and expellers for the edible oil industry, which has expanded considerably in South Africa in recent years; surface condensers for ammonia refrigeration and surface and barometric condensers for water, sometimes for cooling towers; heating elements for hot air drying and apparatus for the drying of powders and other solids, under vacuum or atmospheric pressure, as well as mixers for dry material. Some steam-heated mixers for the preparation of plastic material used in the manufacture of electric storage battery boxes were made recently, and also hydraulic presses for forming the boxes. Kiers have also been manufactured for the treatment of textiles.

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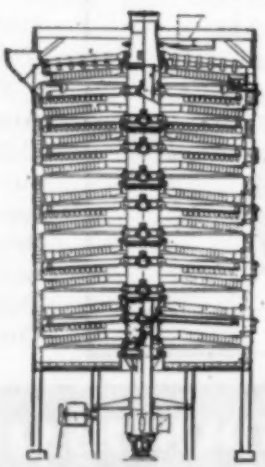

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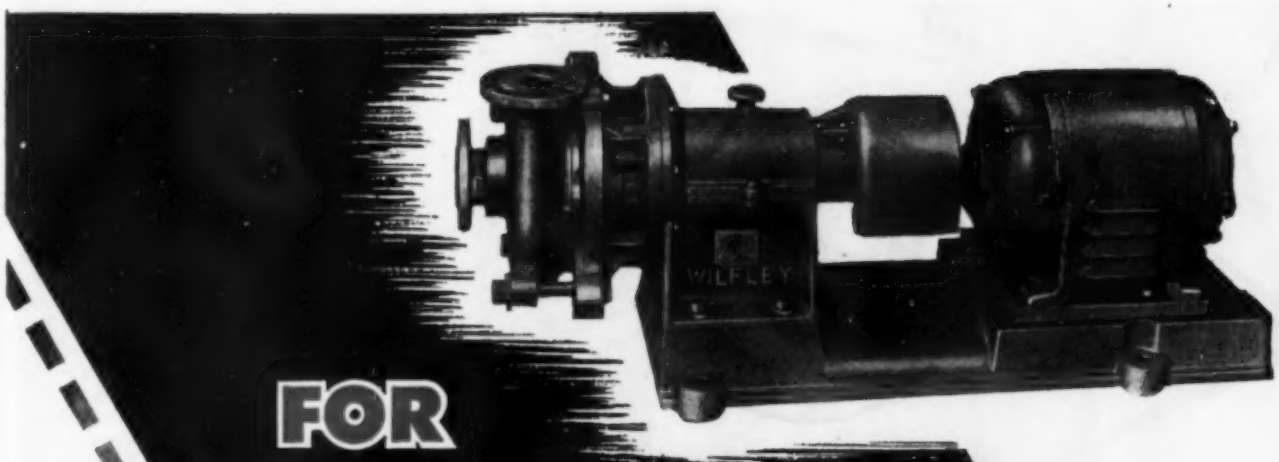

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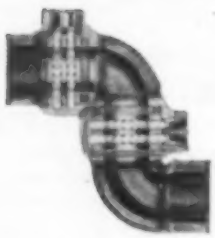

With oil wells going deeper and deeper, it may not be long until depths are stated in miles... not feet! Drillers get more miles of service per foot of rubber rotary hose by using a CHIKSAN *Ball-Bearing* Swivel as end connection (shown in photo above). You can protect your rubber hose and make it last longer, too, by using Chiksan Swivels for connection to gas, oil, air or water outlets... and on all hose reels. Over 500 different types, styles and sizes for every purpose. Write for Catalog.

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With the cooperation of South African manufacturers some new insecticides, stated to be as good as anything formerly imported, have been discovered and reproduced. Dr. Bernard Smit, senior entomologist, Division of Entomology of the Department of Agriculture and Forestry, quotes as a notable example the use of sodium fluosilicate against fruit flies. He says that many chemical imports are coming from new places, such as the Argentine, and the aid of exports is needed to keep dangerous pests out of the country. The parasitic laboratory established at Sunnyside, Pretoria, before the war, has been developed in the last six years. It is receiving useful help from the parasite laboratory of the Imperial Bureau of Entomology in Canada, which has sent in many pests for research.

Chemical manufacturers in South Africa have been giving much attention to producing pest remedies like ant repellants and exterminators, many of which were previously imported. Some local products are sold under brand names which are extensively advertised. Some preparations are made for household use and others for use on lawns, in gardens, bowling greens and golf courses, where white and forage ants do so much damage.

BELGIAN CONGO INDUSTRY

The Belgian Congo chemical industry, founded in prewar days, has been serving many local needs. Several factories produce sulphuric acid, fatty acids and glycerine and various sulphates and chlorates. Copper is treated with sulphuric acid and annually 20,000 tons of sulphuric acid are produced, some for the Rhodesian mining industry. The sulphurous gas needed to make the acid is obtained by roasting zinc concentrates, which are then exported to America. This roasting yields cadmium for use by war industries. Annually 800 to 900 tons of sodium chlorate come from this factory, some for use in the Congo to make explosives, and the rest to make matches in South Africa.

It has long been known that there are considerable deposits of vermiculite in South Africa, but it is only since the war that they have received much attention. Wide use is now to be found for the substance. Among recent South African patents is one for an enamelling process using this mineral. The enamel is said to be more durable than any other type of enamel; it can also be produced in a wider range of metallic-finished pastel shades. Research into other uses of the mineral is under way in Johannesburg. Possibly lubricants produced in South Africa in the near future will contain vermiculite in preference to flaked graphite. As it has the quality of coagulating or hardening oils, it may replace aluminum stearate. It will also be used locally to produce tiles, bricks, pipe covering, roofing, plastic cement, paint, molded articles, sealing compounds, decorative mediums, mural finishes, extenders for gold or bronze printing ink, and flooring. Other likely uses include filters for annealing steel, and for fireproof cartons for films.

South Africa has had to import fair quantities of salt from the United States to tide over a very difficult period of shortage. Weather conditions were largely responsible for the shortage, as there was not

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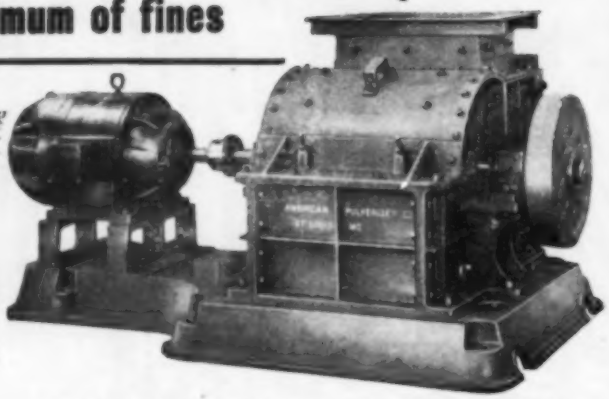

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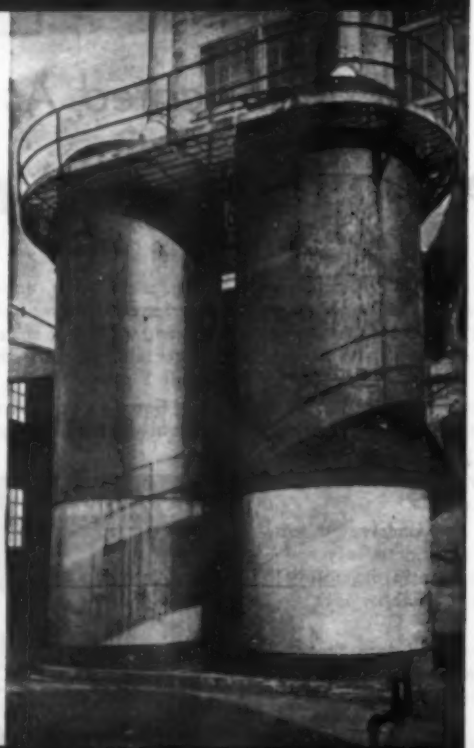

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sufficient dry weather to enable producers to collect the salt, which is not mined in South Africa. It is recovered from brine pumped from shallow pits and boreholes in the "pan" floor. As the pans occur in the more arid districts, the bulk of South African salt is obtained during dry months by solar evaporation in shallow dams—artificial heat is used only by a few producers. Under careful supervision, the quality of the salt, it is claimed, can equal the article imported from America, but occasional dust storms can contaminate it and necessitate grading. The lack of standardization of the various salt grades is considered to be an obstacle still to be overcome by the industry.

Johannesburg firms are making magnesium stearate, zinc stearate, and aluminum stearate for pharmaceutical and cosmetic manufacturing use. They are also making new ammoniated cleansers for hospital, institution and factory use, suitable for cleansing cement walls, concrete floors, wooden floors and for general use. Such firms are also making sulphonated whale oil for the tanneries.

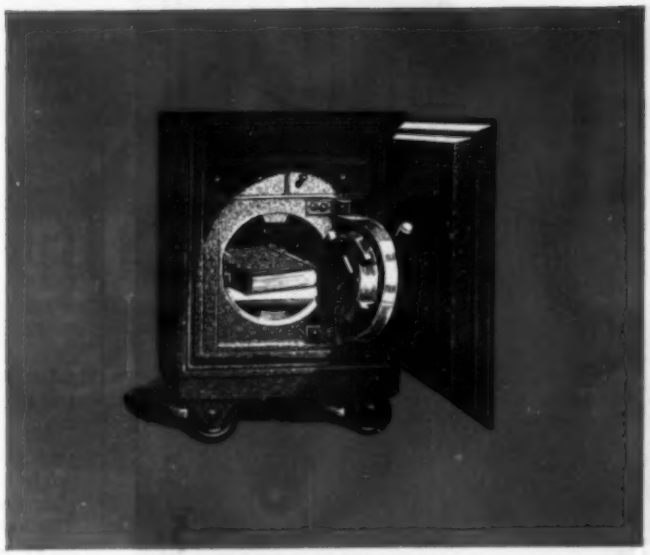
INDUSTRIAL GASES

There are now eight factories in South Africa for the manufacture of oxygen and dissolved acetylene, the demand for which has grown so much the industry has had to expand production. By having factories in different parts of the country deliveries of industrial gases are speeded up, with a substantial conservation of gas cylinders, an important consideration while the existing supply difficulties persist.

The shortage of nicotine insecticides has revived the idea of manufacturing such preparations locally. Nicotine for making such insecticides is obtained from the stalks of the tobacco plant, but some of the difficulties in the way of such production have still to be overcome. Efforts are also being made to increase the import of such insecticides, which are urgently needed by fruit farmers.

A Johannesburg firm has designed and manufactured a new type of self-contained oil treatment plant. A novel filter medium is employed which gives a finesse of filtration comparable with that obtained with edge-type filters. In this unit the mixture of oil and clay is heated under pressure in a closed chamber, the clay being given its maximum absorptive action while the oxidation of oil is simultaneously prevented. One of the units made is designed to treat oil in batches of seven or eight gallons, the whole action being automatic. The heating is electric and is thermostatically controlled. The plant is made entirely of local material and uses a mixture of local active earths for treating the oil.

A number of heavy chrome chemicals are being made in South Africa, and among these are bichromate of soda and chrome tanning salt, and for the paint industry lead chromate pigments. Generally a satisfactory standard of quality has been reached. Many of the raw materials are obtained locally and much of the machinery is also of local manufacture. Most of these industrial chemicals were imported before the war. Such importation may be resumed after the war, but the local industry hopes to maintain its output in active competition with prospective oversea suppliers.



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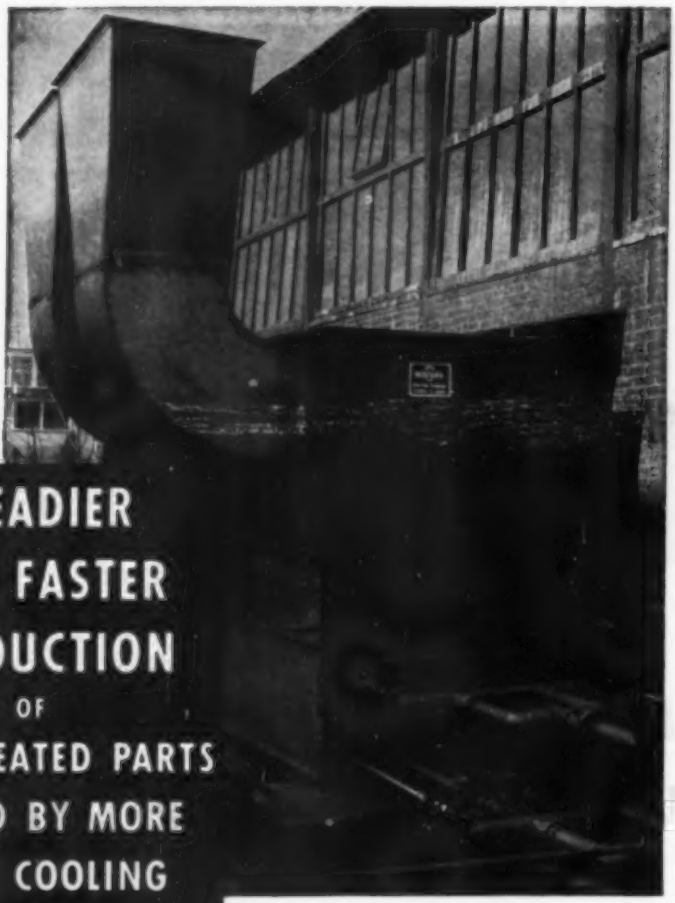

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Once South Africa was dependent on Germany for its lactic acid, but as a result of local research it has been possible to produce all the lactic acid needed, using local materials. Production has developed on so large a scale that there is now a balance available to export to neighboring territories like Southern Rhodesia and the Belgian Congo. The necessary research had been initiated before the outbreak of war and was speeded up when it was realized that the Union might not be able to import this chemical. The lactic acid is now made in considerable quantities by what is known as the Schauder process.

GLASS PLANT IN BOLIVIA INCREASES PRODUCTION

SINCE reorganization in 1937, the single glass plant in Bolivia has greatly increased production. Annual output of all types of glass amounts to about 8,000 metric tons. The value in 1943 was $547,619. Container production runs around 5,000,000 and about 2,000 tons of miscellaneous glass and glassware are produced each year. Production at this plant did not gain real headway until imports were cut down by wartime restrictions and until a certain amount of protection was given by the government.

ARGENTINA EXPORTS LESS QUABRACHO EXTRACT

TRANSPORTATION difficulties and other factors were responsible for a drop in Argentine exports of quebracho extract last year. Private compilations place exports of the extract last year at 121,100 metric tons as compared with 144,500 tons in 1943. Outward shipments of quebracho logs also were curtailed to 200 tons or about one-half the total shipped in the preceding year.

SWEDISH COMPANY PLANS NEW PAPER MILL

A NEW paper mill is to be established at Skarblacka, Sweden. Plans call for production of greaseproof paper and other kinds of cap and wrapping paper. The parent company, the Fiskeby Fabriks A.B., also is said to have under advisement the installation of a new bleaching plant in connection with its sulphate-cellulose and kraft paper mill at Ljusfors.

TUNISIA HAS EXPORTABLE SURPLUS OF OLIVE OIL

LATEST official estimates place Tunisian olive oil production for the 1944-45 season at 75,000 metric tons compared with 42,000 metric tons in the preceding season and 44,150 metric tons as the 1930-39 average. About 8,000 tons of olive oil foots should be available. As domestic requirements for olive oil are expected to be about 30,000 tons, an exportable surplus of 45,000 tons is indicated.

BOLIVIA BUILDS SULPHURIC ACID PLANT

THE Bolivian press is authority for the statement that a new sulphuric acid plant is under construction in the Caicona region of Bolivia. The construction is under the direction of the Ministry of Defense. The

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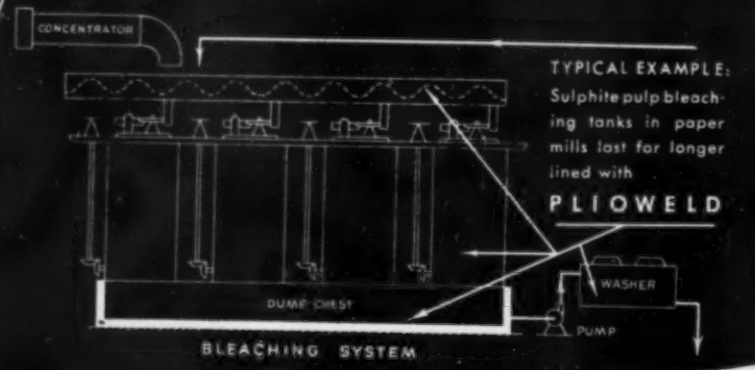
Remember, these savings are attested by long experience throughout the chemical industries. For complete information about **Plioweld**-lined equipment, designed to your requirements, consult the G.T.M.—Goodyear Technical Man. Write Goodyear, Akron 16, Ohio or Los Angeles 54, California.



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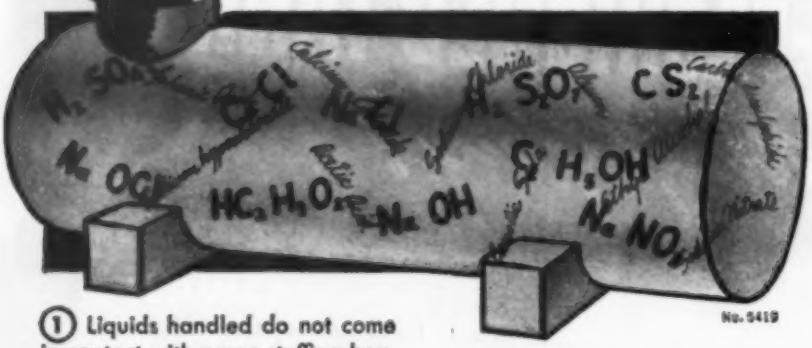

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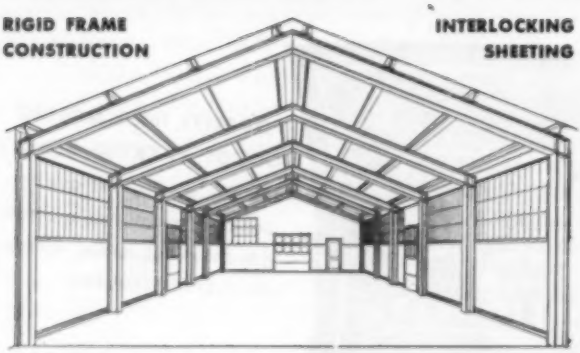

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only information given is that the plant is expected to produce acid at less than the current market price and that profits will be used to expand capacity and to build other plants for manufacturing essential products.

DROP IN CASTOR BEAN EXPORTS FROM BRAZIL

EXPORTS of castor beans from Brazil in the first 11 months of 1944 amounted to 129,897 metric tons as compared with 155,684 metric tons in the comparable months of 1943. In the same periods exports of castor oil were 7,748 tons and 12,627 tons respectively. The maximum exports that can be expected for 1945 are estimated at 140,000 tons of beans and 8,000 tons of oil.

NEW PAINT COMPANIES NOW OPERATE IN PERU

THREE new paint companies began operations in Peru in 1944. One large unit is expected to provide sufficient additional capacity to meet normal demand for the cheaper grades of water and oil paints. Wartime shortages of imported raw materials hampered paint production throughout last year. Ester gums, alkyd resins, and chrome pigments were most difficult to obtain while lithopone and titanium dioxide were scarce at times. Containers and packing boxes also were in small supply.

POTASSIUM CHLORATE MADE BY CHILEAN PLANT

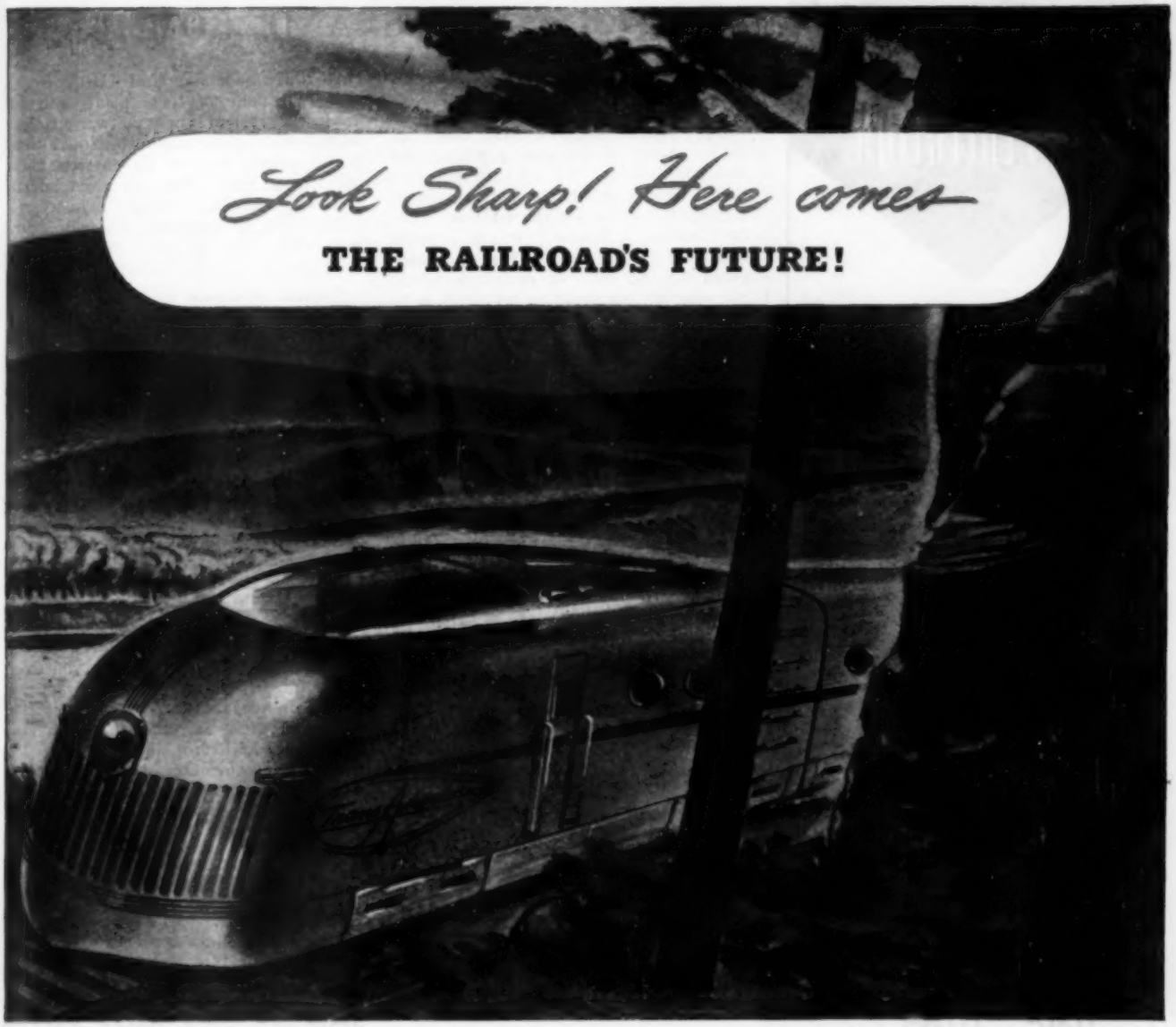
PRODUCTION of potassium chlorate has been started by a firm in Chile with a plant located in Santiago. The chlorate is produced by electrolysis of potassium chloride obtained from deposits in northern Chile. Current output is about three metric tons a month but it could be increased to 10 tons which would be sufficient to meet domestic needs. Formerly potassium chlorate was imported, mainly from Europe. Consumption of chlorate is largely in the match industry with this use accounting for about 99 percent of the total.

NEW CHEMICAL PRODUCTION REPORTED IN MEXICO

ACCORDING to unofficial reports, the Mexican Ministry of Finance has granted concessions to two companies which will result in the production of new chemicals in Mexico. Quimica Industrial Marineda, S. A. Gante, will produce sodium arsenate and sodium nitrate, copper and lead arsenates, yellow arsenic sulphide, zinc stearate, sodium methylarsenate, and copper sulphate. Salico, S. A., Balderas, will produce salicylates, phenol, and acetic acid.

ALGERIAN PHOSPHATE MINE INCREASES OUTPUT

THE most important phosphate mine in Algeria has moved up its rate of production to approximately 30,000 metric tons a month which is 30 percent higher than the rate maintained in 1944. Other phosphate mines in that country are not in operation with the exception of one which is turning out about 1,000 tons a month. Exports of phosphate rock from Algeria in the first two months of this year amounted to 33,825 tons.



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READERS' VIEWS AND COMMENTS

NATURAL vs. SYNTHETIC NITRATE

To the Editor of Chem. & Met.:

Sir:—Your April and May issues included several Washington dispatches and two editorials on the nitrogen situation that I have read with very great interest. I congratulate you on the editorial, "Bitter Controversy Looms." It was a timely statement. While some of the other references may be open to misinterpretation, this one left no doubt in my mind as to where *Chem. & Met.* stands on the issue of public vs. private enterprise.

On the other hand, in reading your Washington despatch, "Standby Plan Promised For America," I do not believe it is possible to avoid the inference that you favor operation of the government's nitrogen plants by the government, if necessary. References to the assurance given Chile by the State Department are quite a different matter and I have no special comment to make regarding them. I am compelled, however, to take exception to other statements, particularly in the last paragraph of that item:

"Naturally, Chile fears that the future opportunity for sale of nitrate in the United States will be very slim if the Government plants are operated effectively for fertilizer manufacture."

The fact is that the only thing we fear is government operation of the plants or the equivalent thereof, such as is provided for in the "free fertilizer" bills S-882 and H.R. 2922 now before Congress. It is our view that none of these plants will be needed in order to supply postwar nitrogen requirements at prices probably lower than prewar prices. But we do not fear their competition unless they are given advantages that are denied private industry.

You seem to doubt our ability to compete with other producers when market conditions become normal again. You say:

"Delivery of natural sodium nitrate to the United States has recently been at prices higher than the actual cost (with profit) of synthetic sodium nitrate. . . . . Synthetic sodium nitrate can be made and marketed at a very much lower cost (than Chilean nitrate) without any subsidy, hidden or direct."

The fact is that on March 19, 1942, Chilean nitrate prices were frozen everywhere in the United States and have remained frozen ever since. It is also a fact that during the war period, freight rates on our ocean shipments were raised from a general prewar average of $4 per ton to $11-$12 per ton. In addition, the price of fuel oil, together with the cost of moving it to Chile, was increased enough to raise our production costs another $2 a ton of nitrate. The "subsidy" to which you refer was nothing more than the absorption by the government of a part of these increases for which the government itself was responsible and which it undertook in order to avoid price inflation of farm products. This procedure, as you doubtless know, was

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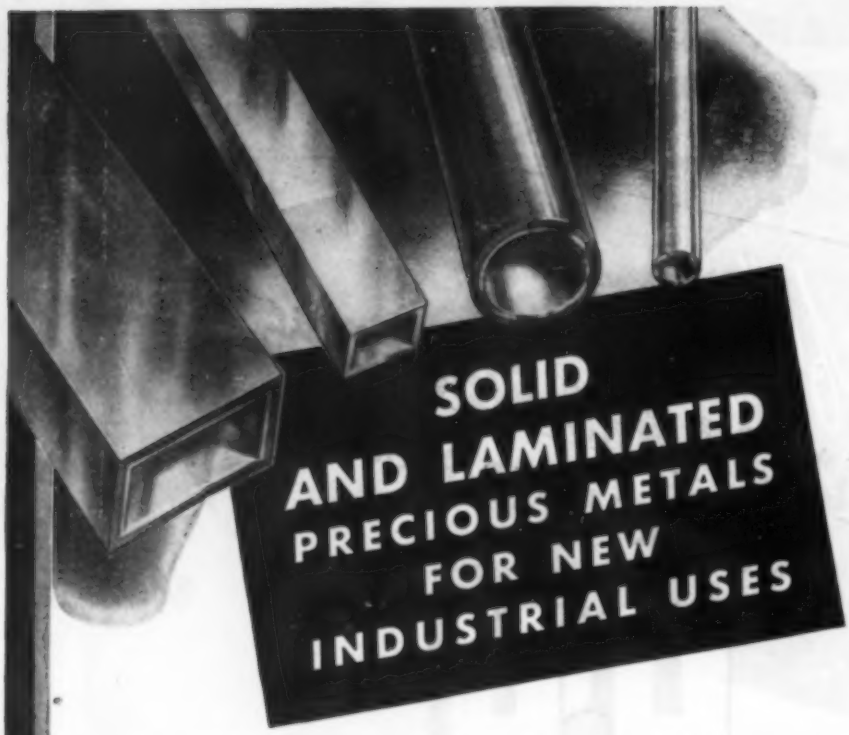

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the one the government employed in many other industries.

Your statements regarding the price of domestic synthetic nitrate of soda, and the cost at which it can be produced, apparently are based upon information not available to us. One fact, of which perhaps you are not aware, is that the domestic product was virtually subsidized by being allowed to base its price at $27 f.o.b. producing point, in bulk, compared with $27 f.o.b. nearest port, prewar, leaving the customer to absorb all freight and delivery charges beyond that point. To illustrate: the ceiling price on natural nitrate is $33 a ton in 100-lb. bags, f.o.b. all United States ports. The synthetic product sells to the fertilizer trade at $30.05 a ton f.o.b. Hopewell, Va. Thus at Jacksonville, Fla., the synthetic price has been $35.87 (prewar $30.05)—Chilean $33.00; Jackson, Miss., synthetic $37.41 (prewar $32.06)—Chilean $35.01; San Pedro, Calif., synthetic $49.41 (prewar $30.05)—Chilean $33.00. Almost everywhere, except in the freight territory served by Hopewell, Va., Chilean nitrate has been cheaper throughout the war period to both fertilizer manufacturers and customers.

"When the lower cost of ammonia, which is now possible at government plants, is taken into account, it is obvious that the State Department proposal would greatly increase the cost of fertilizer nitrogen."

The inference from this statement is that the prewar cost of producing ammonia has been reduced at the government plants. To the best of our knowledge this is not true. Government representatives have said that production at the government plants represents no technological developments that justify the expectation of significantly lower production costs. Aside from this, however, the State Department proposal could not affect the postwar price of nitrogen because private domestic capacity plus imports has always been substantially in excess of consumption. This will certainly be true again.

Before the war, farmers had ample opportunity to buy the kind of nitrogen they wanted at the price level they wanted to pay. They have had a large variety from which to choose. On that basis, Chilean nitrate sales have averaged consistently between 500,000 and 1,000,000 tons yearly. To argue that closing the government plants would increase the cost of nitrogen to farmers, simply means that you believe farmers will continue as in the past, to prefer the natural product, for certain needs and purposes, to any of the other nitrogen fertilizers available to them.

"The natural nitrate is not suitable for mixed fertilizer use."

That statement is unequivocally false and contrary to long established practice.

From what I know of McGraw-Hill as publishers of outstanding trade magazines representing a large section of American industry, I feel certain that you are interested in our views on this question.

J. A. Woods

President
Chilean Nitrate Sales Corp.
New York, N. Y.

CORROSION FORUM

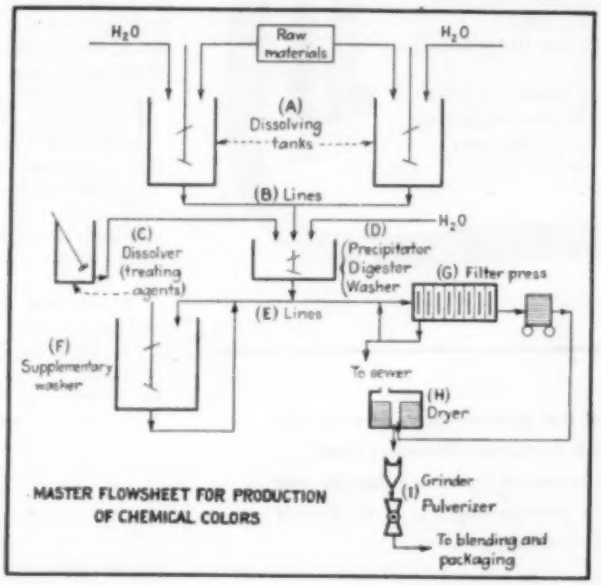
EDMOND C. FETTER, Assistant Editor

MODERN MATERIALS • MODERN METALS

CORROSION REPORTER

MANUFACTURE of chemical colors in America has evolved slowly and reluctantly from the rule-of-thumb, hope-for-the-best practices of early German pigment plants. As progress discards batchwise, tank-burdened processes, so also it promotes a more discriminating use of materials of construction. The following summary of materials used in producing chemical colors comes from a company which has been one of the leaders in transporting the industry from the methods of a 19th century paint shop to those of 20th century process efficiency. It is today one of this country's largest producers of chemical colors.

The accompanying flowsheet shows the arrangement of equipment used in producing each of the four families of pigments to be discussed. Though the same basic process is used for each pigment, there are a sufficient number of these production units to make it unnecessary to process through the same equipment two pigments which might discolor each other. The capital letter preceding each comment refers to the like-designated point on the flowsheet.



MASTER FLOWSHEET FOR PRODUCTION OF CHEMICAL COLORS

IRON BLUES

A) Sodium ferrocyanide, ammonium sulphate, and copperas in separate tanks. Wooden tanks, black iron fittings.
B) Black iron lines and pumps.
C) Chromic acid, cold. Lead-lined tank, lead fittings.
D) Sulphuric acid, hot dilute. Wooden tank, lead fittings.
E) Sulphuric acid, hot dilute. Lead lines, Duriron pump.
F) Sulphuric acid, cold dilute. Wooden tank, 18–8 stainless fittings.
G) Sulphuric acid, hot dilute. Wood.
H) Wet cake. Aluminum trays.
I) Dried cake, flammable. Red bronze because of fire hazard.

AZO ORGANIC PIGMENTS

A) Hydrochloric acid, cold strong, pH of 1–2. Wooden tanks, red bronze fittings.
B) Hydrochloric as above. Red bronze lines and fittings, Durichlor pump.
C) Strong alkali. Black iron tank and fittings.
D) Hydrochloric, cold dilute. Wooden tank; fittings of red bronze.
E) Hydrochloric, cold dilute. Black iron lines and pumps.
F) This operation omitted.
G) Hydrochloric, cold dilute. Wood.
H, I) Same as for iron blues.

CHROME YELLOWS AND GREENS, NITRATE TYPE

A) Nitric acid, cold strong. Wooden tanks, red bronze and/or 18–8 stainless steel fittings.
Chromic acid, cold strong. Lead-lined tank, lead fittings.
B) Nitric as above. Red bronze lines, 18-8 stainless pump.
Chromic as above. Lead lines and Duriron pump.
C) Non-corrosive fixing agents. Wooden tank, iron fittings.
D) Nitric and chromic acids as above. Wooden tank, red bronze and/or 18–8 stainless fittings.
E) Non-corrosive pigment slurry. Iron lines and pumps.
F) This operation omitted.
G) Wood and/or iron.
H) Same as for iron blues.
I) Red bronze for flammable, steel for non-flammable pigments.

OTHER CHROME PIGMENTS

A) Chromic acid, cold strong. Lead-lined tank and lead fittings.
B) Chromic as above. Lead lines and Duriron pump.
C) Non-corrosive fixing agents. Wooden tank, iron fittings.
D—G) Non-corrosive pigment slurry. Wood and iron throughout.
I) Red bronze for flammable, steel for non-flammable pigments.

LITERATURE REVIEW

"INTERGRANULAR Corrosion of Stainless Steel Welds," W. T. Tiffin, *Welding Journal*, Feb. 1945, pp. s125-s128:—Investigation of fractured welds in two boiler superheater tubes indicates that, where austenitic welds are subjected to high service temperatures and pressures, a suitable structure can be produced by heat treatment consisting of a quench followed by normalizing or spheroidizing. It is suggested that heat treatment may not be necessary if the weld metal is not peened.

"PROTECTION of Underground Steel Pipe Against Corrosion," Dozier Finley, *The Vortex*, April 1945, pp. 166-172:—A resume of what has gone before and how matters now stand on the problem of underground pipe protection. Touches on early history, early wrapping experiments, machine wrapping, various materials for covering pipe, causes and mechanics of underground corrosion, cathodic protection, and the three outstanding investigations conducted by K. H. Logan, Scott Ewing, and Gordon Scott.

"A VARIABLE Cycle Alternate Immersion Corrosion Testing Machine," C. H. Mahoney, A. L. Tarr, K. A. Skeie, *ASTM Bulletin*, March 1945, pp. 16-17:—Describes construction of machine used for alternate immersion testing in laboratories of Basic Magnesium, Inc. Forty-eight specimens can be tested simultaneously and machine is capable of widely variable but accurately controlled immersion and drying cycles.

"CATHODIC Protection Overcomes Operating Difficulties in Mechanical Sewage Filters," Albert B. Kozma, *Water Works and Sewerage*, April 1945, pp. 109-113:—Describes in detail the application of cathodic protection to a mechanically cleaned sand filter, a filter so constructed that the sand rests on a copper screen which is in turn supported by a steel grill. Before cathodic protection was applied, galvanic (iron-copper) corrosion necessitated frequent, costly shut-downs to clean corrosion products out of the copper screen. Over a period of years, the unit was non-operative more often than not. However, since cathodic protection was applied a year ago, the filter has operated continuously without shut-downs.

"RECENT Progress in the Mitigation of Underground Corrosion," Kirk H. Logan, *Oil and Gas Journal*, Jan. 13, 1945, pp. 78, 80, 84:—Though corrosion research has been retarded by the war, notable work has been reported by several investigators. Also, a number of corrosion-minded organ-

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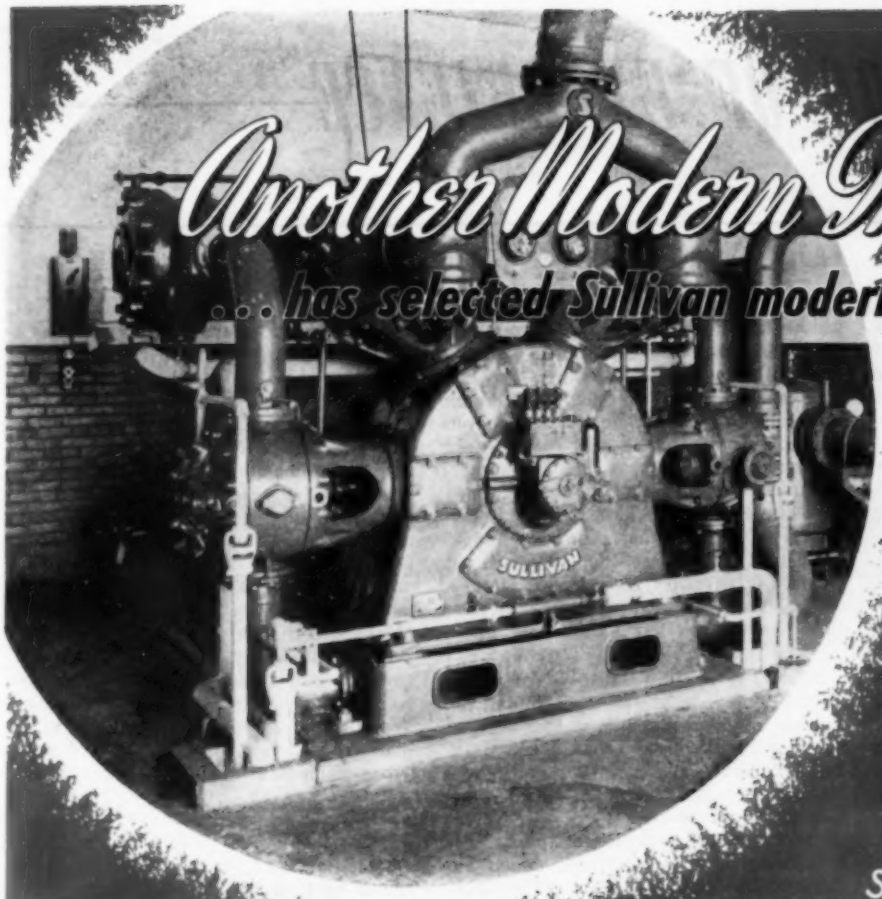
izations have been formed and valuable additions have been made to the literature. The author summarizes these wartime developments in the study of underground corrosion.

"Measuring the 'Existing Corrosivity' of Used Engine Oils," R. G. Larsen, F. A. Armfield, and L. D. Grenot, *Industrial and Engineering Chemistry, Anal. Ed.*, Jan. 1945, pp. 19-24:—A test has been developed which measures the corrosivity of used engine oils more reliably than do the routine tests ordinarily used. The "yardstick" is a 4x0.25-in. strip of copper on which lead has been electrolytically deposited in seven steps of graduated thickness—the thinnest deposit, or step, being 3 (and the thickest, 100) millionths of an inch in thickness. This test strip is immersed in the oil, either in a beakerful or in the crankcase itself, and the oil, as it corrodes away the lead, removes one step after another in the order of ascending thickness. The number of steps removed in a standard length of time is thus a measure of the oil's corrosivity. The object of the test is to help the operator decide when an oil change is necessary and to guide the engineer in determining the causes of bearing corrosion.

"Corrosion of Metals by Organic Acids in Hydrocarbon Solvents," C. F. Prutton, D. R. Frey, D. Turnbull, and G. Dlouhy, *Industrial and Engineering Chemistry*, Jan., 1945, pp. 90-100:—In an effort to determine the influences which might control the rate of bearing corrosion by lubricating oils, a number of factors have been studied, namely, oxygen pressure, nature of the metal and of the solvent, nature and concentration of acid and of peroxide, temperature, and time. While each of these was found to have its effect, the presence of oxygen or peroxide proved to be a necessary condition for the corrosion of lead and cadmium by fatty acid solutions in hydrocarbon solvents. Although corrosion in these media will not take place to any large extent in the absence of acid, the rate of corrosion is mainly controlled by the rate of diffusion of oxidizing agent in to the metal surface and by the chemical rate of oxidation of the metal, rather than by acid strength or concentration. These findings are interesting in view of the widespread inclination to attribute the corrosion of bearing-metals by lubricating oils to the accumulation of fatty acid in the oil as a result of oxidation.

"Bearing Corrosion Characteristics of Lubricating Oils," C. M. Loane and J. W. Gaynor, *Industrial and Engineering Chemistry, Anal. Ed.*, Feb. 1945, pp. 89-95:—A study of the effects of various solid catalysts on the corrosion of bearing-metal by lubricating oils shows (1) that the catalytic effect varies widely depending upon the type of additive in the oil, and (2) that lead oxide is a particularly appropriate catalyst where it is desired to establish correlation between the Indiana stirring corrosion test and the Chevrolet 36-hr. test. Attention is also given to the significance of the nature of the bearing-metal test strips used.



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LIKE so many other industries that have progressed by the bold and continued adoption of better and better methods, materials and machines, aviation has achieved the impossible in production of military planes. The contribution of compressed air from Sullivan *modern* air compressors cannot be emphasized too highly.

This SULLIVAN WN-114, four cylinder semi-radial air compressor recently installed in the newest plant of the largest aviation company, drives hoists, chucks, and boring mills, cleaning, sandblasting and other air equipment and is used at reduced pressures in the all-important air-flow combustion control systems of the power plant itself. Many other aviation companies have similar installations working continuously.

Sullivan Series 100 Air Compressors are two-stage, double-acting, long-lived, heavy duty continuous service compressors—much more compact than old style compressors of the same capacity and yet have operating economies exceeding older and bulkier units. They are available in two and four cylinder models and in single or twin units with capacities from 378 C.F.M. to 3656 C.F.M.

Sullivan Machinery Company, Michigan City, Ind. In Canada: Canadian Sullivan Machinery Co., Ltd., Dundas, Ontario.

SULLIVAN

AIR COMPRESSORS FROM 1/4 TO 3,000 H.P.

PRODUCTS

Stationary and portable air compressors from ¼ to 3,000 H.P., pneumatic casting grips, foundation breakers, portable hoists, rock drills.

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Boston	Pittsburgh	Birmingham	Duluth	Scranton
New York	St. Louis	Knoxville	El Paso	Denver
Chicago	Detroit	Huntington	Butte	Dallas

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

AN EXPERIENCE that every new builder meets is to have his quotation held up as a bait to a favored operator. We prepared plans for a building for old man Holje and, according to our custom, submitted with the bid a complete material list and segregated prices. Holje's realtor delivered these to Contractor Shields, well and favorably known to him. We got the job but not until a reduction had been extorted. Long afterward, the realtor confided that Shields had commended the drawings for their completeness but declined the job at our price.

AROUND 1910, the great Royal Dutch Shell oil interests were setting up their American "beachhead" in San Francisco. The entire establishment consisted of three rooms in the Kohl building, occupied by President Van Eck, Engineer Beers, Manager Gallagher, and some maiden clerks. Eventually plans arrived from New York for the first group of buildings at the refinery site in Martinez. Our bid was accepted without jockeying or haggling. What a contract.

This job included a brick dormitory in the tule marshes at the wharf, the purpose of which was to quarter the Chinese marine servants under U. S. immigration supervision while the ships were discharging gasolene from Sumatra. The drawings were prepared without knowledge of foundation conditions and so it was specified that if greater depth should be required than the drawings indicated, the extra work would be paid for at the quoted unit price for concrete. Beers examined the mud at the site and under the contract, he could have required us to dig through an indefinite depth at a price that had not contemplated sub-aqueous work. Instead, he instructed us to submit a design that would fit the conditions and then proceed with the construction.

The mud was so deep that a pile foundation would have called for an expenditure unwarranted for the light load of a one story building. We therefore borrowed a Chinese device and drove 10-ft. fence posts in a manner which from a devil's eyeview presented the appearance of a bristle brush. In China they employed women to man the hammer cable; we used a gas engine. After this, we built one building after another at the refinery in Martinez and in the oil fields near Coalinga.

Before this time, gasoline was distributed to motorists only at garages and grocery stores. Then "Standard" started establishing those great public conveniences for automobile drivers and Shell followed with vigor. We designed a steel knock-down service station that could be erected in a day's time and then gave it the conspicuous yellow color with bright red trimmings. When the first one was set up on Valencia Street in San Francisco, President Van Eck and an entourage of officials from London went out to inspect. The only criticism forthcoming concerned the finials that decorated the four corners of the marquee. These consisted of glass light-globes topped with the spike of a German soldier's helmet. These helmets had acquired unpopularity in 1915, and so the ornament was changed. Thereafter, the service stations covered the California roadsides almost as thickly as the Western Union trade mark.

THERE WAS in Oakland a group of simple souls banded together under the style of a nationally known lodge. The brethren, innocent of knowledge of business procedure, believed that money could be extracted out of the ether. They somehow scratched together the down payment on a lot and put on a robust campaign for a building fund which raised much enthusiasm but no cash. Brother Phil, bearing allegiance to this aggregation, was pressed onto the building committee and contributed his skill in the preparation of plans for a luxurious meeting hall including some income-producing stores.

A state-chartered savings bank issued a loan of $25,000 against builders' certificates on a contract for a building to cost $45,000, and all of the property was hypothecated to the bank. The actual cash paid over by the bank was $24,000, $1,000 being reserved by the directors as a bonus to be distributed among themselves in return for their magnanimity. In addition to the mortgage as security, they collected the signatures of the members of the building committee which included Phil. Somehow Phil became hypnotized into aligning himself on a $25,000 note with six fellow directors, none of whom could spare a five-spot from his monthly bread-and-butter wage.

Anyhow, as might have been anticipated, the completed Hall, beautiful though it was, sold no stock. We held the bag and in addition, the bank's attorney wrote a billet-doux requesting Phil at his convenience to drop in and liquidate his note for $25,000. They already had the entire property and furniture, valued at about $55,000 for which they paid $24,000.

At this point, attorney "A. G." (A. G. Kazebeer), schoolmate from Nebraska, took over. He met with the bank directors and remainded them that collecting a thousand dollar bonus as a condition precedent for a shaky loan would send them all to the state penitentiary at Folsom if the secret leaked out. He was willing to bury the secret and in fact he did. The price included the cancellation of the note, and making certain cash concessions which reduced our loss. The investment, however, turned out profitably for the bank.

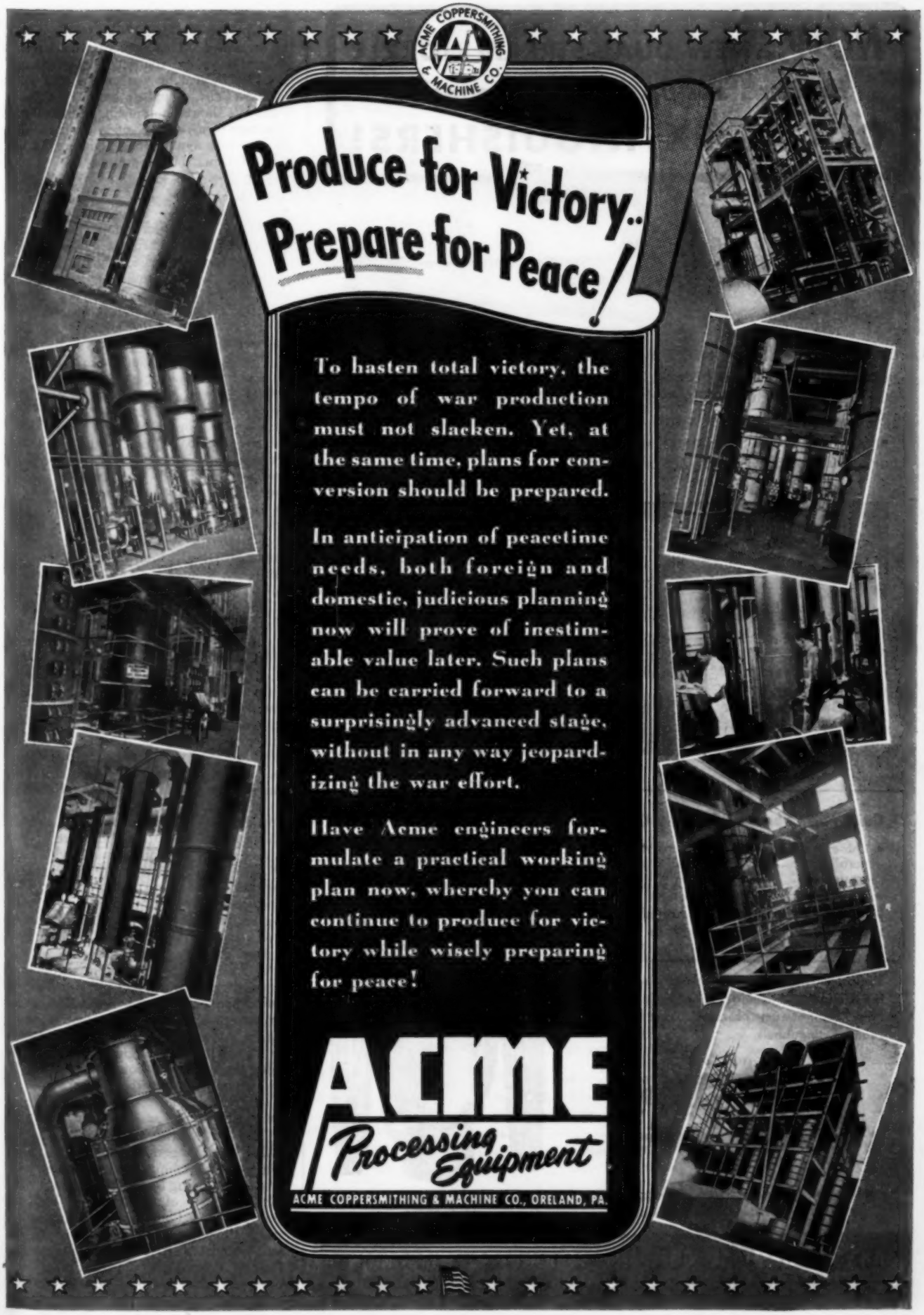
WHEN STOCKTON STREET tunnel was projected, Architect Herman Barth, of pleasant memory, was selected by City Engineer's Office to prepare an estimate of the cost of supporting the abutting buildings during the tunneling operations. This required crawling around, turtle fashion, under three or four blocks of buildings, estimating their weight and making designs of supports to carry the loads to a safe depth, and finally preparing a detailed cost for him under our presumption of accepting his good will in recompense. We cheerfully proceeded and, after several weeks of painstaking work, delivered with our compliments, a big book of figures and sketches.

Then Barth, instead of expressing his thanks which would have been ample remuneration, sent us a check for $25! When we thus learned what esteem these artists placed upon our time and skill, we despaired of achieving goal along this line within a reasonable period of time.

We therefore re-directed our path and confined our solicitation for jobs to industrial organizations and the Government. These outfits open bids in public and the low bidder gets the job. There is no sentiment attached to their manner but loyal effort attracts cooperation that puts joy into the work. And a man cannot perform indifferently when he likes his job! Furthermore, "smooth goes the job where the profit is good."

UNDER ENCOURAGEMENT of a San Francisco city ordinance, prohibiting the use of garbage for hog feeding, old man Turner came out from the East with the intention of building a plant for reclaiming soap grease and chickenfeed from garbage collected from hotels and restaurants. He introduced himself as the former owner of such a plant in Chicago and stated that we had been recommended as skilled in the design of garbage works. We announced a willingness to accept the commission but admitted only a reading knowledge and some slight acquaintance absorbed by sidewalk superintendence during the construction of a plant at Columbus, Ohio. The Columbus plan was the very one he desired to follow! Thereupon, he spent an hour making crude sketches to translate his desires, and then departed with a promise to return in the morning.

Directly we dug into the back files of *Engineering News* and located the description of the Columbus garbage reduction plant and others. By the guidance of the descriptions and drawings we were able to complete a general plan by the time Turner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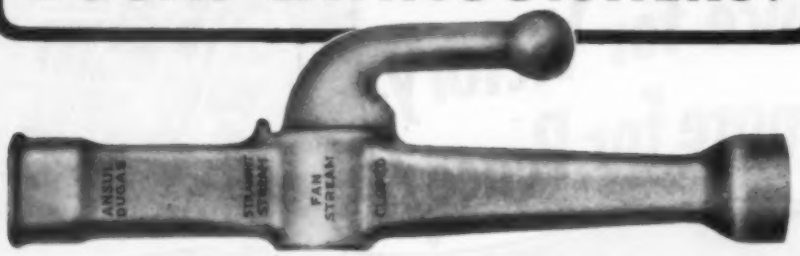

NEW DUAL-STREAM NOZZLE deals effectively with spill fires and fires difficult to reach because of height or obstructions. Designed for use with DUGAS wheeled extinguishers, the new Dual-Stream Nozzle greatly increases fire fighting range and effectiveness. A turn of the handle gives a *straight* stream with a range of 45 feet—or a *fan* stream with a range of 15 feet.

STRAIGHT STREAM of fire-killing DUGAS Dry Chemical permits a large fire to be knocked down from a safe distance before operator goes in to extinguish it.

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***Quick Facts about* DUGAS Dry Chemical**

- For extra-hazardous fires involving flammable gases, liquids, greases or electrical equipment.
- Not an electrical conductor.
- Non-toxic, non-corrosive, non-abrasive.
- Not affected by extreme cold or heat.

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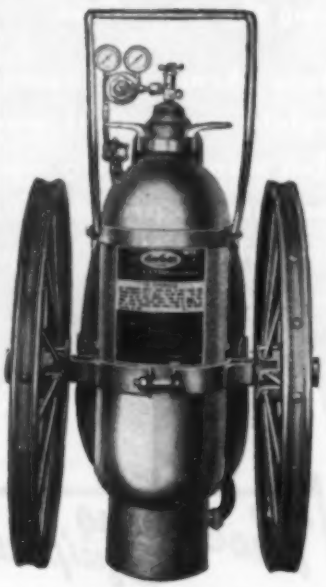

DUGAS 150-A WHEELED EXTINGUISHER

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DUGAS DIVISION

arrived in the morning. When he caught sight of the drawing, his eyes bulged and he exclaimed, "That's exactly what I want. Where in — did you get all the information?" His delight was emphasized with expletives that would do credit to a stevedore! We showed him in *Engineering News* a picture of his own plant in Chicago, and in the foreground stood Turner himself with his thumbs in his armpits.

In due course we helped in the selection of a site near Hunters Point in San Francisco, and built a handsome plant for $125,000. Operation got under way and promised profit. Then a City Supervisor, who had formerly owned a hog farm in the suburbs, induced his colleagues to join him in repealing the ordinance that had put him out of business, and thus allow him to return to hog production. Turner sold his works to a soap company.

The complicated plant which cost money to build and operate could not compete with the hogs. A hog is a portable garbage reducing plant with automatic technical supervision and being otherwise completely equipped with elemental machinery for stoking, digesting, extracting, and refining. It does not pay taxes and is not required to submit to collective bargaining or to contribute to the support of indigent and other impedimenta. Its sole performance is pork production with a single by-product which is thrown over the fence to assist nature in the propagation of vegetables.

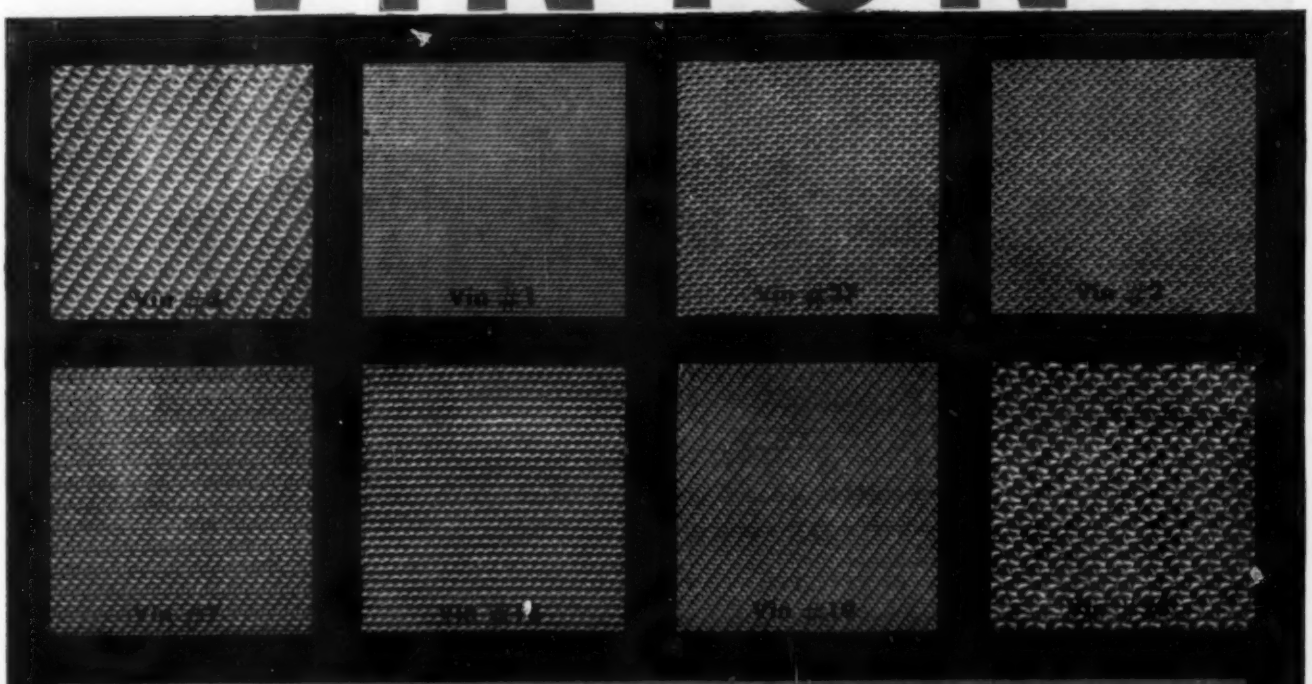
Turner retired to a farm in Santa Clara County where we used to visit him on Sunday afternoons. He built his house on an elevation which he called "Turner's Bluff."

A few blocks from the garbage plant in Butchertown, there was a glue works founded by old man Holje and presently operated by Kindlespire. It could easily be located by the nose. Absence of competition in glue manufacture on the Coast made plant efficiency an academic subject like swimming to a philosopher. However, when an earthquake began rattling the four-story timber frame building, philosophizing had no virtue. We prepared a stress analysis and found timbers with loads of 50,000 lb. which had slipped within two inches off the supporting posts! By instructions from Kindlespire, we pulled the structure together and braced it with steel rods and turnbuckles.

Our departure at completion of the work greatly relieved him as he was in continual fear lest we should pick up some of the alchemy of his art. We called his attention to the fact that notwithstanding his forty years' practice, he was still losing an occasional kettle of glue. After doing a thing wrongly a few thousands of times, he had stumbled onto the answer, and he placed a value thereon in proportion to its cost in effort and wasted glue.

The market price of some of his highly prized secrets was no more than an hour's lecture to a freshman. We suggested that he attach a young Bachelor of Science from the University of California to his staff with the prediction that this young fellow could apply the tools of research to determine effective operating technique and thereby accomplish more in the next three years than had been done in the past forty. He followed the suggestion and

VINYON*



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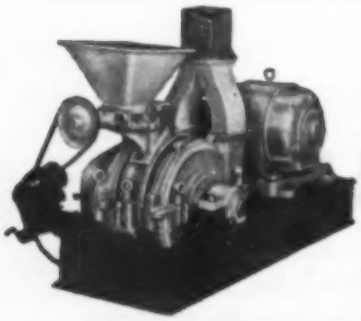
Therefore, for best results the pulverizer used must be specially designed for each particular material. That is why every MIKRO-PULVERIZER is designed and built specially to meet the particular and peculiar requirements of each individual application.

It is true all MIKRO-PULVERIZERS have the same general outward appearance. Nevertheless, each mill is a special unit designed to give best results on the specific application for which it is intended—the only truly "custom-built" pulverizer. Research laboratory and test grinding facilities and service are available without obligation. Submitting to us a 5 to 50 lb. production test sample of your material with full details is the proper method of adequately meeting your pulverizing needs.



THE MIKRO-ATOMIZER
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after a couple of years his mystery began to dissolve into a science. The yield per ton of raw material increased. However, he did not relish a challenge to his supremacy as master glue maker of the Pacific Coast, and accordingly discharged the chemist after three years of service.

Operation of the plant suffered from shortage of steam and a boiler salesman advised another boiler. However, the plant was using live steam for evaporating in a coil pan while the exhaust steam from the engines was wasted to the atmosphere. We prescribed a triple effect evaporator which would cost about the same as a boiler, but it would use the surplus exhaust and thereby save fuel whereas the boiler consumed it. Then he corroborated our advice by consulting a dealer in second hand equipment and bought an evaporator ill-suited to the job. He did not have the patience to wait for the home talent to acquire operating skill, so he discontinued the evaporator and installed a boiler!

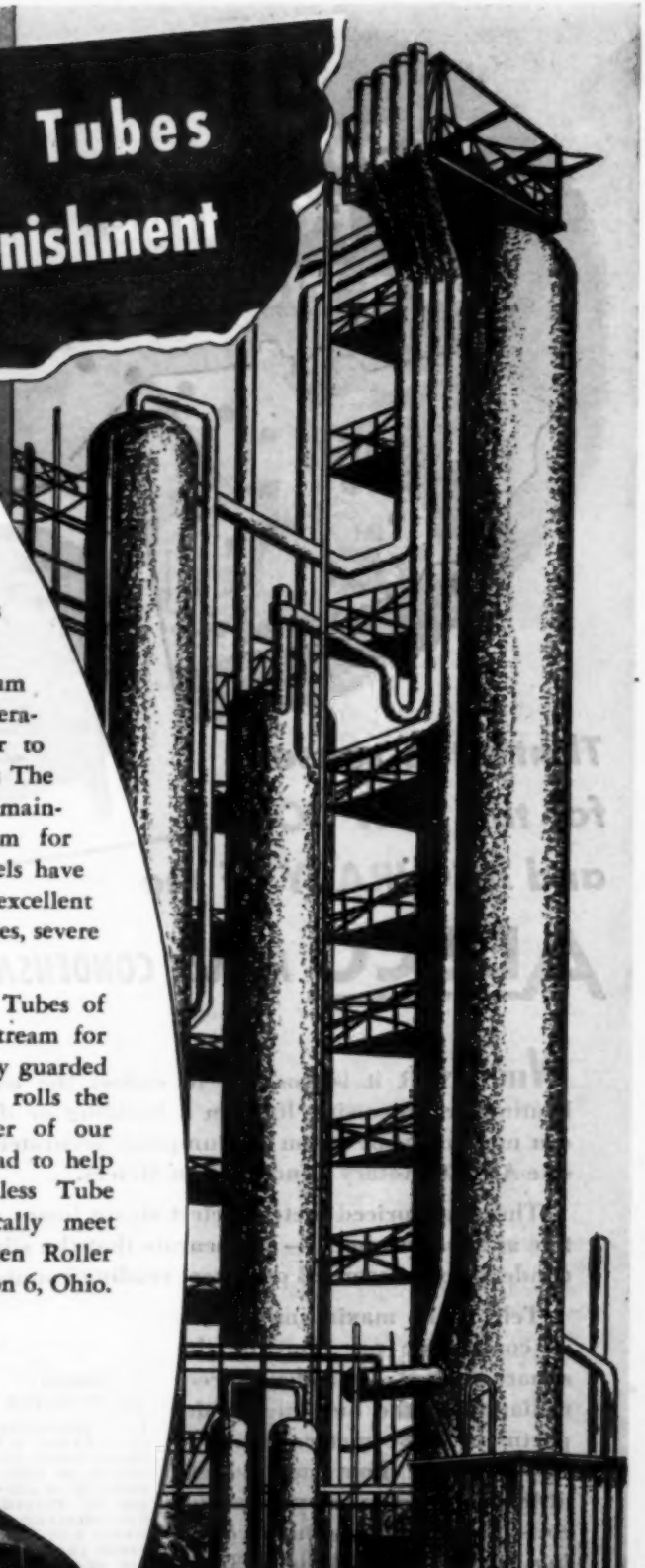
For a period, sans chemist, and sans new-fangled contraptions, happiness returned; then competition, assisted by freight reductions at the completion of the Panama Canal, began to crowd him from the East. When the opportune time arrived, his business sagacity asserted itself and he sold his plant to his Chicago competitor.

FIREWORKS flared up one night at the Benicia Arsenal and blew the roof off a stone warehouse built before the Civil War. We won the contract for removing the upper stone work and reconstructing the building. The ornamental overhanging corner lookouts, consisting of huge blocks of limestone, having been weakened by the fire, were teetering on the wall. The Colonel expressed timidity about our proposed method of removing them. He suggested a ginpole seventy-five feet long. Our plan was to let gravity do the work, and so while the chronicler was discussing the matter in the Colonel's office, Phil and the foreman clambered up the wall with crowbars and pried the blocks off. They came down with a thud, and the procedure, having been successful, was approved.

NATURAL SODA PRODUCTS CO. of Inyo County, was passing through the struggle of building a new plant. The engineer presented himself wearing a long face and he stated that he needed a lime kiln for burning dolomite, but he didn't know how to build it and had no money to employ an expert. We asked him if he had $50 to pay the draftsman if we would contribute the design. His countenance registered relief and in a week he joyfully got his plans. A little later we heard that the sample kiln performed with profit and they built five more—using our fifty-dollar plans.

We also dabbled in magnesite. Ralph Moore, one-time engineer and manager of the Spreckels beet sugar house, became interested in a magnesite mine near Mondota, Calif. Magnesite was used for making sinks, drain boards and hard walls, and for floors as a substitute for terrazzo. The American market was supplied from Italy and the price was high, and thus invited local competition. When word got back

Timken Seamless Tubes can stand terrific punishment



Behind the amazing development of the super-fuels that give our war machines tremendous power, is an equally sensational story about development of steels for high temperature service.

To produce new, efficient fuels, petroleum refiners are forced to ever higher temperatures and working pressures. In order to meet these extreme working conditions The Timken Roller Bearing Company has maintained a continuous research program for the past 17 years. As a result new steels have been developed. Steels able to give excellent performance in spite of high temperatures, severe pressure and corrosive conditions.

You can depend on Timken Seamless Tubes of these steels to keep your refinery on stream for longer runs because their quality is closely guarded by one organization that melts the steel, rolls the billets and pierces the tubes. A member of our technical organization will be glad to help you select the Timken Seamless Tube that will most economically meet your needs. The Timken Roller Bearing Company, Canton 6, Ohio.

A request written on your firm's letterhead will bring data on 15 steels for high temperature service. Just ask for Technical Bulletin Number 20, "A Guide For Users of High Temperature Steels."

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These low priced meters detect steam losses and are as positive as a water wheel — so accurate that the slightest trickle of condensate is recorded on direct reading counters.

Tell us the maximum pounds of condensate per hour or the square feet of equivalent direct radiation in the building or department to be metered and we will tell you how surprisingly little it will cost to put your steam consumption on a sound accounting basis. Ask for Bulletin 35-80 and No. 35-83CM.

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to Italy that the native sons were starting to develop the home product, the Italians cut the price. The infant industry had not acquired self-supporting stature by the time the cut was made and so it flopped. There was no tangible remuneration in the job for us. However, an occasional trip to the mountains with a congenial sugar tramp like Ralph provided an antidote for mental cobwebs. The nights were tranquil in the mountains and the ham and eggs were good.

WHILE THE Oakland, Antioch & Eastern R.R. was under construction, we built the various appurtenances along the line. The formula was to submit a design and a complete list and prices of materials and labor, appended by the customary 10 percent to cover overhead and compensation. President Napthali scrutinized the figures, demanded some concession in the price, and then "settled" with a bang of his fist on the desk. With a dozen jobs a month, a 50-dollar reduction on each job gave him the feel of accomplishment. However, the cut was unreasonable for the service rendered, and so we buried 50 dollars in the estimate of each job for the purpose of later deducting it. This procedure had the practical effect of maintaining contentedness in the presidential mind which inured to the benefit of the stockholders. Occasionally, he let a job to a competitor, but he always came back.

I = MOMENT OF INERTIA to a structural engineer but to bombastic Bill it was the Index to his self esteem. He was superior to the laws of nature and he boasted the ability to out-drink any man on the job. As master mechanic he selected some random beams from the graveyard and, without benefit of engineering advice, ordered the boys to erect them in the attic above the eighth floor to support a new tank. Quick decisions give the impression of erudition but in Bill's case they were hollow bombast. He viewed the completed job with satisfaction and then brazenly ordered, "fill'er up." In a few minutes Bill deflated. Nobody was hurt but 36 tons of sirup came tumbling down the stair wells to the cellar.

There is a rule of thumb for the strength of beams, previously mentioned in this column, that fits even Bill's order of intelligence if he would only give heed. To wit: The safe uniformly distributed load in thousands of pounds that a beam can carry (based on the old 16,000 lb. tensile strength) equals the product of the Depth and the Weight divided by the Span, i. e. DW/S. Thus, a 15-in. I at 42 lb. per ft. and 21-ft. span = 30 thousand lb. ($15 \times 42/21$). Try it and check it against an old handbook.

THE NEW SECRETARY found difficulty in spelling the name of a nearby town. With impatience she was asked if she had never traveled. She admitted with chagrin that she had never strayed far from her mother's fireside, but on the other hand her father had traveled aplenty. This inspired some interest and was followed by the inquiry as to her father's profession. She answered proudly, "He's a milk man."

NAMES IN THE NEWS

J. S. Walton

M. E. Fogle

C. E. Williams

J. S. Walton, professor of chemical engineering at the University of Oklahoma, has been named acting head of chemical engineering, Oregon State College, Corvallis.

Richard P. Carter has been named chief chemist of the Hercules Powder Co.'s Mansfield, Mass., chemical plant. Dr. Carter has been with Hercules since 1940.

Milton F. Beecher, director of research for the Norton Co., Worcester, Mass., has been awarded an honorary degree of doctor of engineering by Iowa State College.

Robert E. Wilson, chairman of the board and chief executive officer of the Standard Oil Co. (Ind.) has been elected a member of the Board of Trustees of the University of Chicago.

John L. Keats who has been a member of the chemical department of E. I. du Pont de Nemours & Co. for almost 22 years, has retired from all active work.

Clair N. Sawyer, formerly director of Wisconsin Lake Pollution Survey, and more recently special technical investigator for the South Dakota Board of Health, has been appointed associate professor of sanitary chemistry in the department of civil and sanitary engineering at the Massachusetts Institute of Technology.

O. S. Duffendack, director of research for North American Philips Co., has been appointed vice president and director of research and engineering.

Francis J. Curtis of the Monsanto Chemical Co. has been elected chairman of the American Section of the Society of Chemical Industry. At the same time **Sidney D. Kirkpatrick**, editor of *Chem. & Met.*, was elected vice-chairman, and **J. W. H. Randall** and **Cyril S. Kimball** were re-elected to serve as treasurer and secretary, respectively.

Marlin E. Fogle has resigned from Weston Electrical Instrument Corp. and accepted a position with DeJur-Amsco Corp. as chief electrical engineer.

Roger Williams has been elected a vice president and member of the board of directors of E. I. du Pont de Nemours & Co. He succeeds **Charles M. A. Stine** who has retired after 38 years with the company.

Frank E. Murphy, formerly assistant to manager of Research and Development Department, has been appointed director of Development Division, Research and Development Department, Pennsylvania Salt Mfg. Co., Philadelphia. He will be in charge of chemical engineering including pilot plant operations, engineering research and related fields of work.

Gustave T. Reich has resigned his position as technical director of the Pennsylvania Sugar Co. to go into consulting work with offices in Philadelphia.

H. M. Hooker, formerly president, has been elected chairman of the board of Hooker Electrochemical Co. and **E. R. Bartlett**, executive vice president, has been elected president.

C. L. Bryden has left Infilco, Inc., and is now associated with The American Research and Testing Laboratories, Chicago, as consultant.

N. A. Hanley, of the Department of Industrial Development of the Western Australian Government, has returned to Perth after six months in the United States in connection with plans for developing the Australian wood distillation industry.

Edwin L. Oliver, president of Oliver United Filters, was given an honorary degree of doctor of laws by the University of California on June 23.

Clyde E. Williams, director of Battelle Memorial Institute, Columbus, has been presented with the degree of doctor of science by the Case School of Applied Science, Cleveland. The degree was presented in tribute to Dr. Williams' leadership in advancing industrial science.

Eleanor Leland, on June 27, received the first B.S. degree in chemical engineering ever awarded a woman by the School of Engineering at Columbia University.

Edward F. Wagner has joined the Witco Chemical Co., New York, as chief chemist, and will be engaged chiefly in directing product development work. Dr. Wagner was formerly with the Standard Oil Co. of Ohio.

Edwin L. Hall has resigned his position as manager of the Manchester (N. H.) Gas Co. to become the secretary-coordinator of gas production research for the American Gas Association. This project functions for the supervision of those investigations in gas production which are aided by or coordinated with the Association program at colleges, other institutions, or member-company plants. Mr. Hall will work out AGA headquarters in New York.

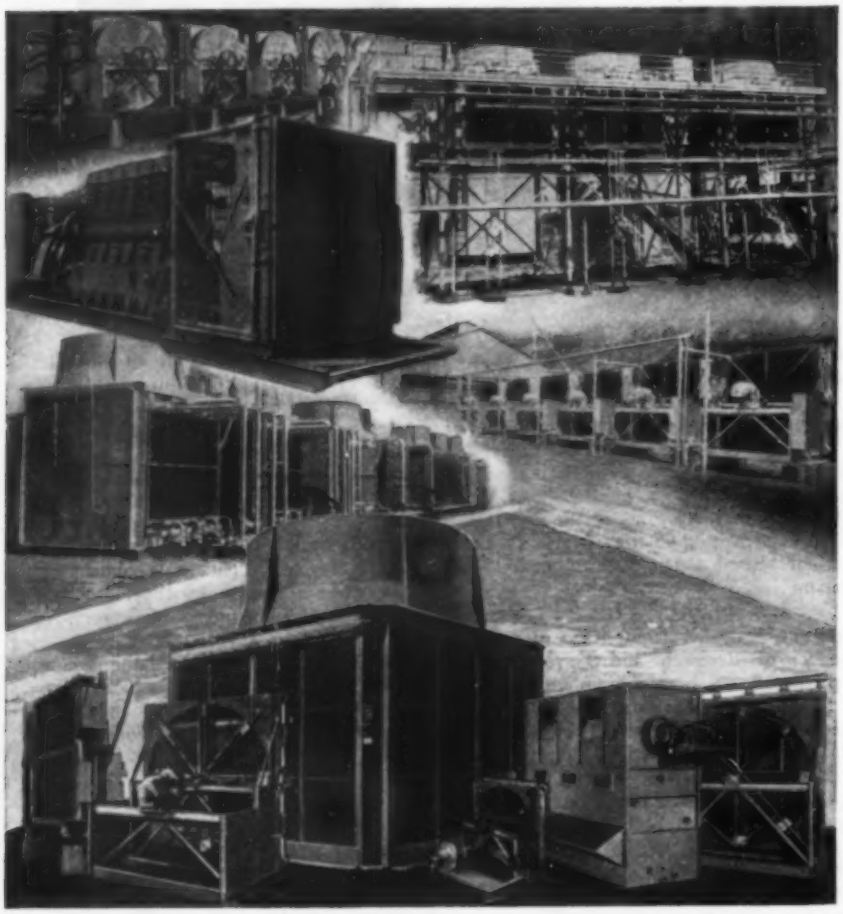
C. C. Concannon, chief of the chemical unit, Bureau of Foreign and Domestic Commerce, has gone to Lima. He is expected to remain in Peru most of the summer as adviser to the Peruvian government on chemical development matters.

William W. Winship, Jr. has joined the Thermal Syndicate as assistant to the New York manager. Mr. Winship, a graduate of Washington and Jefferson College with graduate study at Columbia University, had been with the Coco-Cola Co. for several years.

D. J. Sullivan has been named assistant plant manager of the Fairfield, Conn.

HEAT TRANSFER SPECIALISTS

TO THE OIL FIELD AND PETROLEUM INDUSTRIES



Changes come fast in the oil industry. New processes replace old, and make new problems in heat transfer. For more than a quarter century, Young engineers have worked with petroleum and chemical engineers, solving new problems as they came. That's why Young stands ready now with the experience, "know how", and manufacturing facilities to design and produce special or standard heat transfer units for every need.

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plant of the Fabrics Division, of E. I. du Pont de Nemours & Co., and **G. T. Vaala** has been transferred from the Chemical Department, Experimental Station in Wilmington, to the same plant as assistant director of the laboratory.

E. J. Reddert and **L. A. Ledgett** have been appointed chief engineer and assistant chief engineer and director of engineering design, respectively, in the new organizational setup for the Central Engineering Division of the Colgate-Palmolive-Peet Co., Jersey City. Mr. Reddert has over-all responsibility for all engineering activities of the company excluding research. Mr. Ledgett will be in charge of all phases of engineering projects from inception or pilot plant up to construction of production plant.

C. W. Deane is to head the newly formed chemical engineering and process design department at Colgate-Palmolive-Peet Co., working under the direction of Mr. Ledgett. He will be in charge of the chemical engineering phases of the company's processes. Dr. Deane has been with the company since early in 1941.

Norman Ferrara has been made head of the general engineering department of the Central Engineering Division of Colgate-Palmolive-Peet Co. He also will be responsible to Mr. Ledgett and is in charge of plant layout, mechanical and electrical design, estimating, equipment specifications and procurement. Mr. Ferrara has been with the company since September 1941.

Stuart O. Fiedler, who for several years has been connected with the C. F. Burgess Laboratories as a research chemical engineer, has joined the staff of Bjorksten Laboratories in Chicago as a research associate.

C. Lewis Wrenshall has resigned his position as assistant technical superintendent, E. I. du Pont de Nemours & Co., Alabama Ordnance Works, to accept a position on the staff of Southern Research Institute, Birmingham, Ala.

T. F. Burton, who has edited *Transactions* of the Society of Chemical Industry since 1915 and the Annual Reports of the Progress of Applied Chemistry since their inception in 1916, has become full time editor and secretary of the Bureau of Abstracts. **Stephen Miall,** editor of *Chemistry and Industry,* has retired. **T. W. Jones,** who for a number of years has been editor of *The Industrial Chemist* and related journals, has been made editor and manager of the Society's publications.

Carl B. McLaughlin has been named head of the recently established engineering service division of Tube Turns, Inc., Louisville.

William I. Beach, chief plastics engineer of North American Aviation, Inc., has been awarded the fourth annual John Wesley Hyatt Award for outstanding

LENGTHEN LIFE EXPECTANCY

of Chemical Processing Equipment

with Republic **TOUGH ENDURO**

The interior surfaces of these chemical processing kettles are made of 4 gauge Republic ENDURO Stainless Steel, Type 316.

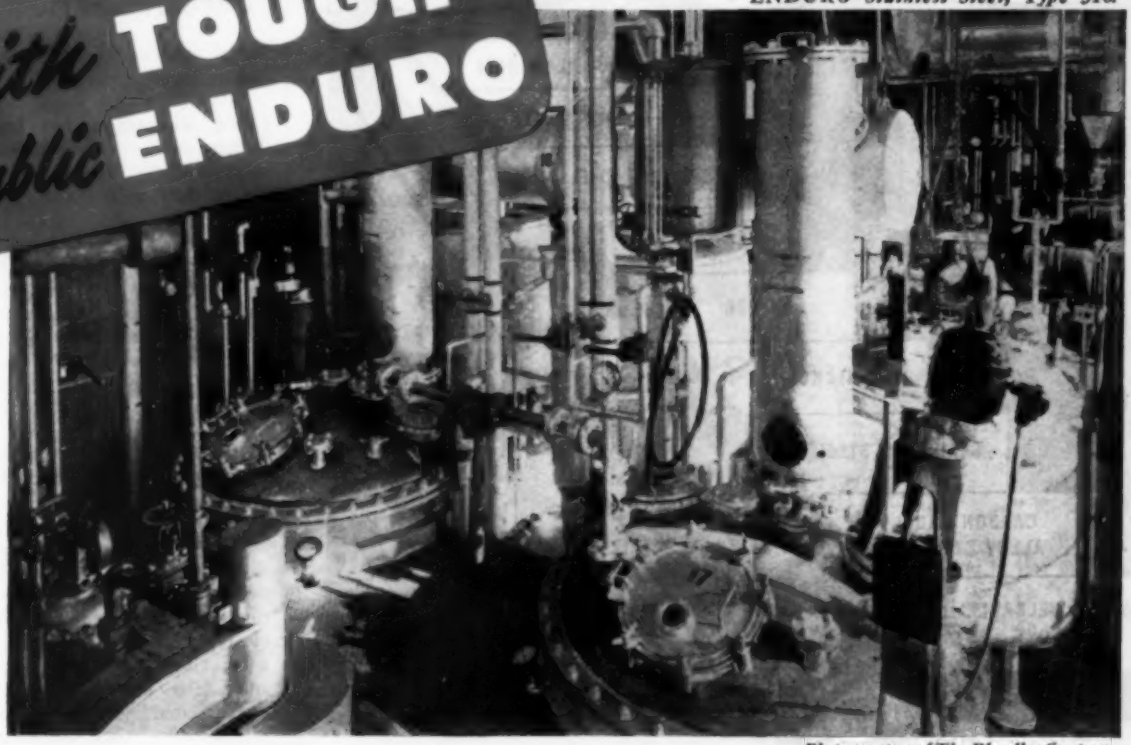

Photo courtesy of The Pfaudler Company

● Unsurpassed resistance to corrosion and high temperatures are only two of the many advantages of Republic ENDURO Stainless Steel. Yet these are important reasons why this versatile metal is lengthening the service life of many types of chemical processing equipment.

ENDURO withstands the corrosive action of most acids and alkalies—hot or cold. It resists scaling when subjected to extreme heat. And in both elevated and sub-zero temperatures, ENDURO retains its high strength—up to 185,000 p.s.i. in some analyses.

ENDURO fabricates readily by all modern methods into practically any shape or design. Trays, tanks, pressure vessels, valves and vats, are but a few of the applications in which ENDURO can cut your replacement and maintenance costs to new low levels.

Your equipment manufacturer will be glad to tell you more about these and other profitable advantages of using Republic ENDURO Stainless Steel for your processing equipment. Or, if you prefer, write directly to:

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CORROSION RESISTING
TUBING

One length **or a million**

The Youngstown Welding & Engineering Company makes welded tubing of the proper type material to best withstand your corrosion conditions. It is available in odd or standard sizes, in limited quantities or carload lots. It will meet your requirements for pressure and uniformity. Special equipment with low setup charges permits production of special tubing for individual needs at a practical cost.

FITTINGS AND FABRICATED PIPING

A complete line of Weldco fittings is available. Weldco's well-equipped plant is in position to fabricate the entire pipe assembly you require.

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Specialists in Corrosion Resistance

achievement in the plastics industry. The gold medal and $1,000 award was established in 1941 by Hercules Powder Co. and was awarded this year to Mr. Beach for his work on the postforming of laminates which made possible the the manufacture of certain critically needed parts for the aircraft industry.

A. P. Hellwig has resigned from his position as manager of technical service and specialty products division of the American Maize-Products Co.

Meyer Angruss has been appointed general manager of the Phillips Chemical Co.

Grant Richardson has been appointed director of the paper division, WPB, to succeed **Walter H. Wilcox** who is returning to duty with the S. D. Warren Co.

E. J. Hergenroether, recently resigned chief of the metallurgical branch of the Steel Division of WPB, has resumed his duties with the development and research division of the International Nickel Co. Inc., New York. He is in charge of the division's automotive steel development and will make his headquarters in Detroit.

Mathew M. Braidech has been made director of research for the Division of Engineering Standards and Fire Protection of the National Board of Fire Underwriters. The activities of the new division will bring about a closer collaboration between industry, the Underwriters Laboratories and the insurance field in the face of rapid technological advances. They will include problems connected with fire and related hazards of industry and commerce, materials of construction and method for their use, and protective methods in safeguarding life and property.

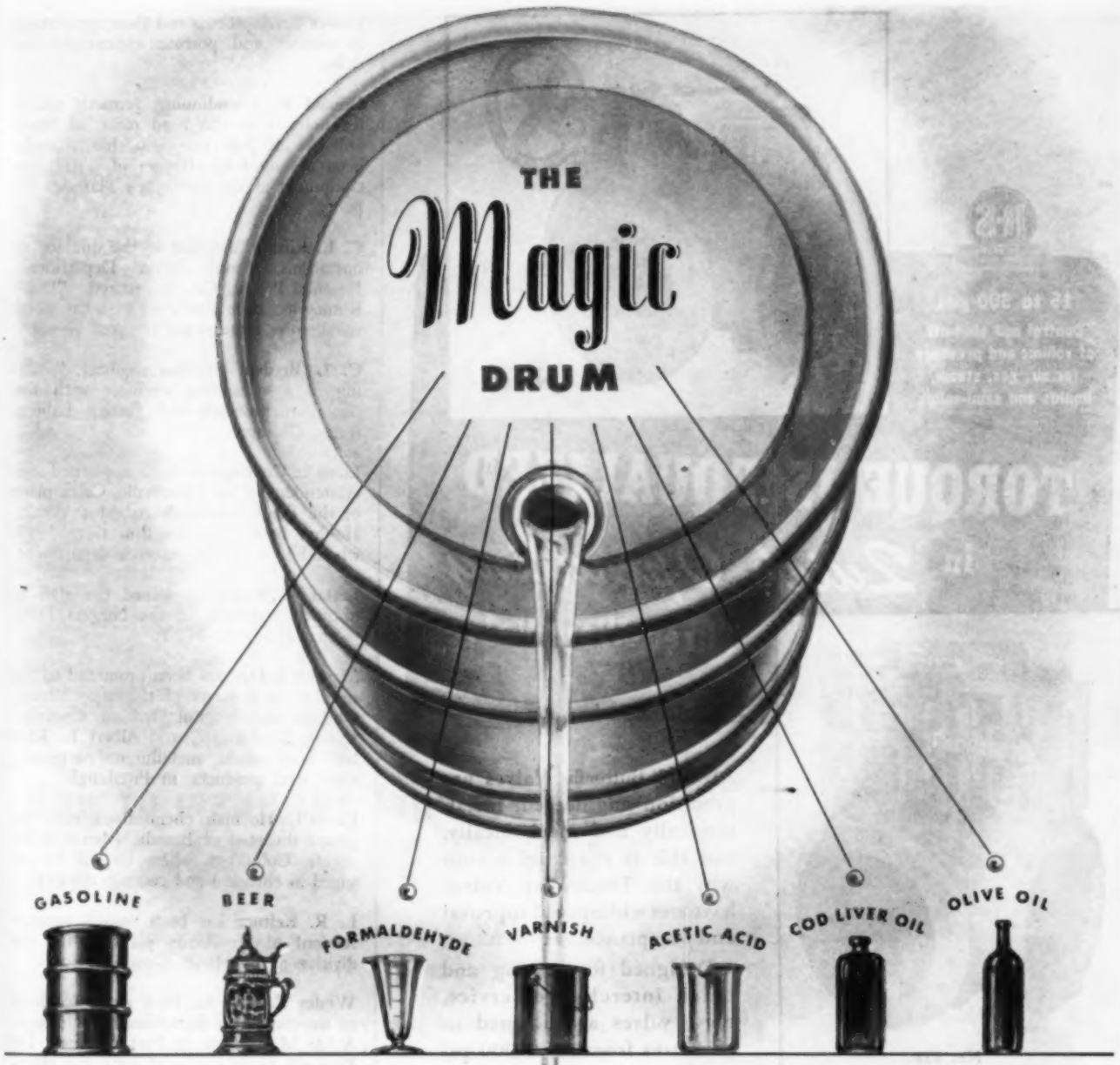
Albert R. Tucker has recently been appointed west coast manager of the Electrochemicals Department, E. I. du Pont de Nemours & Co., with headquarters at El Monte, Calif. Mr. Tucker will consolidate the El Monte plant and sales offices and the district office at San Francisco. He is a graduate in chemistry from Butler College.

I. G. Stewart of the Columbia Chemicals Division of Pittsburgh Plate Glass Co. has been appointed manager of the new San Francisco office of that firm.

J. D. Long of Tacoma, Wash., head of the research department of Douglas Fir Plywood Association, has recently been elected president of the American Society of Agricultural Engineers, which maintains administrative offices at St. Joseph, Mich.

H. R. Jenks has been promoted to general manager of the National Research & Mfg. Co. in National City, Calif.

Don Gaston, formerly staff engineer for Consolidated Vultee Aircraft Corp., has joined the National Research & Mfg. Co. in National City, Calif., where he will direct production of new plastics and ad-



Food, petroleum, paint, beer, chemicals and the products of many other industries have, in years past, found safekeeping in Alcoa Aluminum drums.

The urgency of war turned Alcoa's hand to making tens of thousands of aluminum drums for shipment of vital gasoline over the Burma Hump to our airmen in China. Built of aluminum, each drum weighs 31 pounds less than a conventional drum, yet has the strength to withstand rough handling.

The outstanding service record of these lightweight aluminum drums, used in war, proves their worth to postwar shippers of many products.

Lower shipping costs and easier handling are but two of the major advantages of Alcoa Aluminum containers—barrels, drums and carboys. Alcoa engineers can advise you on containers suited to your individual requirements.

Write ALUMINUM COMPANY OF AMERICA, 2151 Gulf Building, Pittsburgh 19, Pennsylvania.

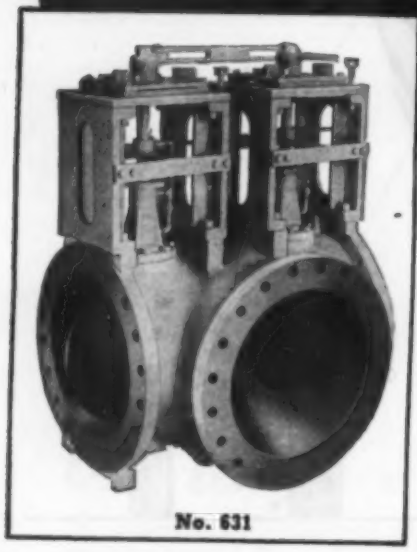
ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

No. 630

15 to 900 psi
Control and shut-off of volume and pressure for air, gas, steam, liquids and semi-solids

TORQUE IS EQUALIZED in *Quick Operating* Three-Way Valves



No. 631

All R-S Butterfly Valves are precision engineered, metallurgically and mechanically, and this is the chief reason why the Three-Way Valves have met widespread approval and acceptance.

Designed for mixing and quick interchange service, these valves are adapted to pressures from 15 to 900 psi and for elevated or sub-zero temperatures. In manual operation, four to six revolutions of the hand wheel fully open or close the valve vane. Adjustable linkage is usually provided so that the mixture can be changed at will.

With a pressure drop across the valve, the vane tends to close itself. The torque on the closed right-hand vane (see illustrations) is opposite to that on the open left-hand vane so that the torque is equalized and no excessive load is placed on the motor in power-operated installations.

Available in sizes from four to sixty inches. Write for details and Catalog No. 14-B.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4523 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

hesives developments and their application to aircraft and postwar commercial articles.

Donald W. Glendinning, formerly senior technologist at the head office of Shell Oil Co. at San Francisco, has recently been advanced to manager of distillation equipment at the company's Martinez refinery.

C. E. Kinney, assistant to the director of operations, Naval Stores Department, Hercules Powder Co., has retired. "Doc" Kinney has been associated with the wood naval stores industry for the past 40 years.

C. L. Bryden, filtration engineer, is acting as a consulting engineer with the American Research and Testing Laboratories, Chicago.

Louis L. Collonge has been appointed superintendent of the Emeryville, Calif. plant of the Plant Rubber & Asbestos Works. He has been with the firm since 1937, when he joined the research department.

Lester C. Books has joined the staff of filtration engineers of the Niagara Filter Corp. of Buffalo, N. Y.

Maurice J. Day has been promoted to the position of manager of the alloy bureau, Chicago Metallurgical Division, Carnegie-Illinois Steel Corp., and **Albert L. Kaye** has been made metallurgical engineer, alloy steel products, in Pittsburgh.

Erwin C. Hoeman, chemical engineer, has joined the staff of Battelle Memorial Institute, Columbus, where he will be engaged in chemical and ceramic research.

L. R. Keltner has been named superintendent of the Akron plant of the tire division of The B. F. Goodrich Co.

Wesley E. Pyke has been appointed head of the chemistry department of Colorado A. & M. College at Fort Collins. Dr. Pike will be in charge of both the chemistry department and the chemistry section of the college experiment station.

OBITUARIES

Harold Hibbert, 67, recently retired professor of cellulose and industrial chemistry at McGill University, formerly of Yale University, died May 13.

Charles Hardy, 65, president of Charles Hardy, Inc., and the Hardy Metallurgical Co., died June 8.

David Owen Evans, 69, vice president of the International Nickel Co. of Canada, and chairman of the Mond Nickel Co., Ltd., died in London on June 11.

Allan V. Ritchie, 59, superintendent of the Texas Co.'s research laboratory at Beacon, N. Y., died suddenly in New York on June 19.

Herbert J. Winn, 74, chairman of the board of Taylor Instrument Cos., died in Rochester, N. Y., June 27.

How to make the Japs lose face and SAVE MATERIALS

The Jap prisoners, shown above, have lost face — plenty! But, thanks to Multiwall Paper Bags, they are saving materials . . . by the truckload.

For, Multiwall Paper Bags have ample strength to prevent losses of materials caused by breakage . . . rough or careless handling. These bags are made from 2 to 6 thicknesses of tough paper and specially treated inner plies.

And, because Multiwalls are moisture resistant, they guard materials from damaging dampness in storage or in transit.

On home fronts as well as fighting fronts, you'll find that Multiwall Paper Bags are "delivering the goods" most efficiently and economically. If you want to know how they can save money and material for you, write or call your nearest St. Regis office TODAY!

Tight, sturdy Multiwalls prevent losses caused by pilferage or infestation. They also help to keep storerooms clean.

Because Multiwalls are easy to stack and handle, they save valuable loading and unloading time.

St. Regis Bag-packing Machines accurately preweigh a product and quickly pack it into Multiwall bags. This frequently means a saving of extra labor and equipment.

MULTIPLY PROTECTION • MULTIPLY SALEABILITY

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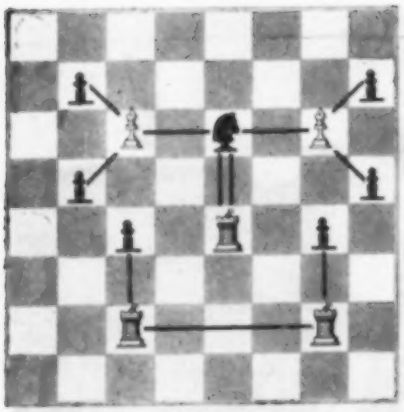


Plan your next move with

BECCO UREA PEROXIDE

This is a ridiculous chess-board set-up, but it does represent an excellent formula—Becco Urea Peroxide, a white crystalline material containing 16 per cent active oxygen. It is very readily soluble in water and is also soluble in alcohols and certain other organic solvents. It possesses good storage stability. It contains water-free hydrogen peroxide.

It is available as crystalline powder or as tablets.

A FEW APPLICATIONS:

Used extensively for pharmaceutical and cosmetic preparations.

Its outstanding characteristic of containing water-free hydrogen peroxide, makes it applicable as an oxidizing, bleaching and polymerization agent for use in non-aqueous systems.

The available supply of BECCO Urea Peroxide is limited at present.

ACTIVE OXYGEN IS ON ACTIVE DUTY

Other Becco Products:

Electrolytic Hydrogen Peroxide —100 vol. (27.5% by weight)
Ammonium Persulfate**
Potassium Persulfate
Magnesium Peroxide*
Calcium Peroxide*
Zinc Peroxide*
Pyrophosphate Peroxide*
Sodium Carbonate Peroxide*
Acetyl Peroxide*

*Available in research quantities only at present.
**Will be available after the war.

BUFFALO ELECTRO-CHEMICAL COMPANY, INC.

BECCO SALES CORPORATION
SALES AGENTS BUFFALO 7, N. Y.

INDUSTRIAL NOTES

General American Transportation Corp., Chicago, has acquired the Eclipse Moulded Products Co. of Milwaukee. Operations will continue as before under the same management.

The O. Hommel Co., Pittsburgh, has organized a chemical and equipment division. James F. McCrory will head the new division assisted by Charles F. McGovern.

General Alloys Co., Boston, has appointed Herbert King field representative for California with offices in Tilden Sales Bldg., San Francisco. Offices also will be opened in Los Angeles, Seattle, and Portland.

Clark Equipment Co., Buchanan, Mich., has elected George Spatta president to succeed the late Albert S. Bonner.

Pittsburgh Plate Glass Co., Pittsburgh, has named J. H. Henshaw general export manager. He will be aided by C. H. Tilp, Pittsburgh office, in charge of glass export; W. J. Werner, Newark plant, in charge of paint export; and J. Rivera, Baltimore, in charge of brush sales.

Proctor & Schwartz, Inc., Philadelphia, has advanced George W. O'Keeffe to the position of vice president in charge of dryer division sales.

Graver Tank & Mfg. Co., Inc., East Chicago, Ind., has placed N. B. Graham in charge of sales of water treating and process equipment sales in the Tampa, Fla., area.

C. P. Hall Co., Akron, has appointed Sam A. Davis vice president and general manager of the Chicago offices and plant of C. P. Hall Co. of Illinois.

National Research Corp., Boston, has added E. C. Bowen to its sales staff. Mr. Bowen formerly was eastern divisional sales manager for Central Scientific Co. of Chicago.

The Timken Roller Bearing Co., Canton, Ohio, has elected Albert L. Bergstrom vice president and placed him in charge of all engineering activities.

Allis-Chalmers, Milwaukee, has transferred J. C. Schaefer from field engineer at the Pittsburgh office to branch office manager at Youngstown, Ohio.

Johns-Manville, New York, announces that Walter J. Nelson has returned to the company where he has resumed engineering, sales and development work at the New York headquarters.

The Neville Co., Pittsburgh, is now represented in the mid-west by the newly formed E. P. Lambert Co. with headquarters in the First Central Tower, Akron, Ohio.

American Cyanamid Co., New York, has appointed James Gorman divisional man-

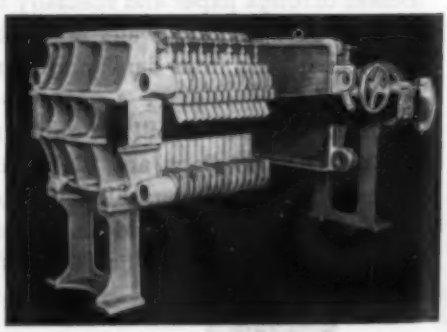
BETTER FILTRATION for Any Corrosive Condition at Any Temperature and Pressure

Whether you want to filter a pint or 200 gallons per minute, the Shriver Filter Press supplies everything you're looking for in operating efficiency, speed and ease, regardless of the nature of your product and the necessary temperature, pressure or other factors required to clarify, thicken the slurry, recover the solids, or wash, extract or dry them.

No filtering equipment offers as much performance versatility and economy in more processing fields.

Shriver Filter Presses are made for any filtering capacity—of any metal, rubber, wood or plastics—stationary or portable units.

Write for new Catalog No. 45 to T. Shriver & Company, Inc., 802 Hamilton St., Harrison, N. J.



Shriver side feed, closed delivery, washing type filter press with visible discharge; plates and frames of stainless steel

Shriver Filter Presses

Save TIME • SPACE • LABOR • INVESTMENT

In gauging the potentialities of

your future Far West operations . . .

count on Columbia for Alkalies

THROUGH recently acquired Pacific Coast facilities, Columbia brings to the great far west area the efficient and economical production of basic chemicals so beneficial to the entire industrial economy.

The rich alkali deposits at Owens Lake, California—consisting principally of Soda Ash, Borax and Sesqui-Carbonates—are an important addition to other Columbia resources. Their acquisition is characteristic of the progressive policy which seeks to anticipate the growing requirements of customers to the greatest extent possible.

For complete information on our ability to serve your operations in the far west—present or contemplated—you are invited to consult our General Offices, or the most conveniently located District Office.

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PITTSBURGH PLATE GLASS COMPANY
COLUMBIA CHEMICAL DIVISION
GRANT BUILDING • PITTSBURGH 19, PA.

CHICAGO • BOSTON • ST. LOUIS • PITTSBURGH • NEW YORK • CINCINNATI • CLEVELAND
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NEW HORIZONS IN VARIABLE SPEED CONTROL

PROPAGATING LIFE-SAVING PENICILLIN

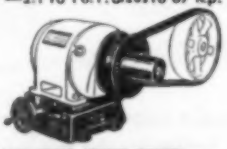
● In the propagation of Penicillin, the miracle, life-saving drug, it has been found that the Rotating Tanks used in the process must be driven at speeds which are *infinitely and accurately* variable.

To insure the exact speed required for each changing condition in the process, The Graver Tank & Manufacturing Co. equips its Propagating Tanks with REEVES Vari-Speed Motor Pulleys. Rotating speeds can be adjusted instantly and to fractional r.p.m., while the tank is in motion, merely by turning the REEVES handwheel.

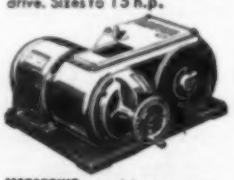
REEVES Speed Control is the answer to accurate production control in a large number of manufacturing operations—drying, separating, feeding, cutting, drilling, stamping, conveying, mixing, heating, cooling, winding, etc. It is standardly provided on 1,866 different makes of driven machines. Look for the familiar REEVES handwheel on any new machine you buy. It is your assurance of greater versatility, uniform quality and larger output. Easily installed, too, on machines in service. Send for 96-page Catalog C-450.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

VARIABLE SPEED TRANSMISSION provides infinite, accurate speed flexibility over wide range —2:1 to 16:1. Sizes to 87 h.p.



VARI-SPEED MOTOR PULLEY converts any standard constant speed motor to a variable speed drive. Sizes to 15 h.p.



MOTODRIVE combines motor, speed varying mechanism and reduction gears in single unit. Sizes to 15 h.p.

Accurate Variable

REEVES SPEED CONTROL

ager of the fertilizer branch. He will handle all sales for agricultural purposes in the eastern part of the country.

Food Machinery Corp., San Jose, Calif., has added A. F. McGraw to its staff in the capacity of director of sales. In addition to his business activities Mr. McGraw for the last four years has been chairman of the advisory council of the Farm Equipment Institute.

Worthington Pump and Machinery Corp., Harrison, N. J., has appointed S. Riley Williams director of international business. He will direct foreign and export activities and will supervise operations of associated companies abroad.

Ludlow Valve Mfg. Co., Troy, N. Y., has placed Jack C. Lyle in charge of sales in the southern territory. He will make his headquarters in Atlanta.

American Cyanamid Co., New York, has advanced George F. Ballard to the position of sales manager to handle distribution of Florida pebble phosphate rock.

American Brake Shoe Co., New York, has advanced J. L. Mullin from general superintendent of foundries to vice president in charge of operations of the American Manganese Steel Division.

R-S Products Corp., Philadelphia, has appointed the Fluid Controls Co. of the same city, exclusive distributors for its valves in Delaware, eastern Pennsylvania and southern New Jersey.

Stone & Webster, New York, has elected Lt. Col. Whitney Stone president to succeed George O. Muhlfeld who becomes vice chairman of the board. Mr. Stone is a son of the late Charles A. Stone, one of the founders of the company.

George S. May Co., Chicago, has established in a Pacific Coast division with headquarters in the Russ Bldg., San Francisco. Harold J. McElhinny, formerly director of the regional survey department, becomes manager of operations of the new division.

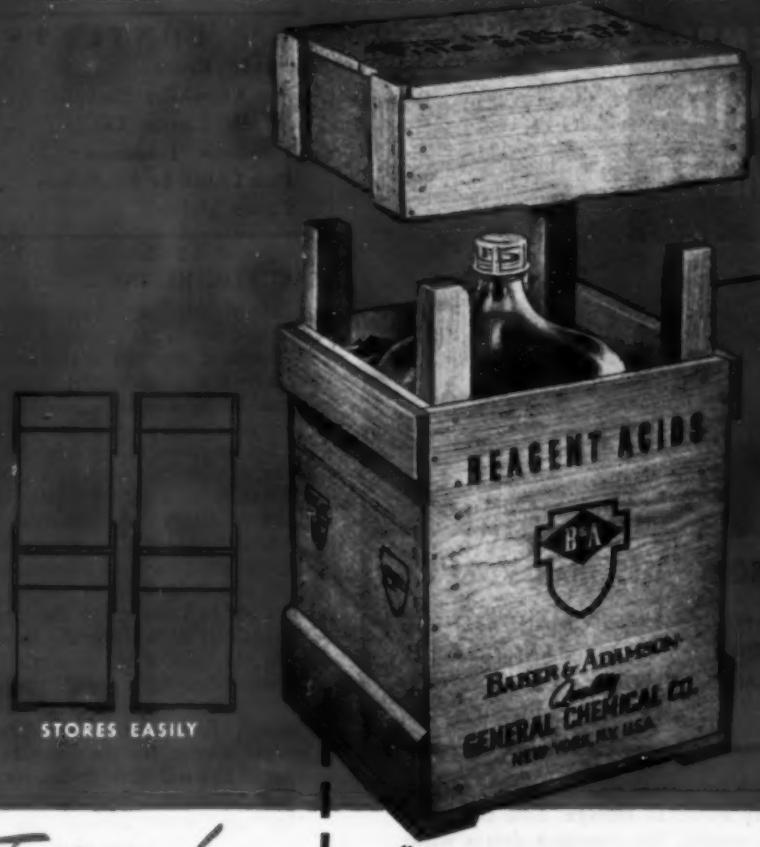
United States Rubber Co., New York, has appointed Dr. William F. Tuley assistant general sales manager of the Naugatuck Chemical Division. Dr. Tuley had been serving as plant manager at the Kankakee Ordnance Works where he is succeeded by John W. Ackerman.

Godfrey L. Cabot, Inc., Boston, has promoted Owen J. Brown to the position of general sales manager. J. Boyd Britton also was promoted to assistant to the vice president in charge of manufacturing and sales.

Builders-Providence, Inc., Providence, has taken on Fred W. Deutsch as assistant sales manager. Mr. Deutsch had been vice president of the Everson Mfg. Co. until earlier in the year when he resigned.

The Marco Co., Wilmington, Del., has moved its manufacturing and laboratory facilities to Third and Church Sts. The laboratory has been enlarged and is being equipped with the latest improvements in apparatus.

General Chemical INTRODUCES



6½ Gallon Carboy
Completely Enclosed
Screw Cap Closure
POURS EASILY
HANDLES EASILY
STORES EASILY

Featuring!

✓ **"ONE-MAN" PACKAGE**
Compact . . . saves labor . . . lower gross weights make possible *one-man* handling and storage—

	Gross
Sulfuric Acid	138 lbs.
Nitric Acid	113 lbs.
Hydrochloric Acid	102 lbs.
Ammonium Hydroxide	86 lbs.

✓ **"PURITY SEAL" COVER**
Completely encloses bottle, keeps out dirt, prevents sunlight damage to pure acids.

✓ **POUR-CLEAN LIP**
Superior pouring control . . . easier emptying into small containers.

✓ **SCREW-CAP CLOSURE**
Added security in sealing, yet simpler opening and closing. Keeps bottle neck clean, protects acid from contamination.

✓ **SAVES STORAGE SPACE**
Store *more* acid in *less space* . . . rectangular solid package with reinforcing corner posts adaptable to storage in solid tiers, or on pallets. Takes less room than commercial carboy with protruding neck.

✓ **"FULL VIEW"**
Contents completely visible . . . acid level easily determined.

✓ **EXTRA STRENGTH BOTTLE**
Designed for superior strength and uniformity.

✓ **RESISTANT COATING**
Entire box weather-proofed for longer life and better appearance.

"THE CARBOY OF TOMORROW" Today!

For B & A Reagent Acids and Ammonia

Chemical packaging makes a significant advancement with the advent of the new 6½ gallon, screw-cap, completely boxed carboy . . . and General Chemical Company leads the way by pioneering this superior modern container for its Baker & Adamson Reagent Acids and Ammonia.

Here is a carboy that protects the high purity of B&A products and safeguards their quality for the user even under adverse conditions. Study its many special features. Note how they provide an ease of handling and storage impossible with ordinary carboys.

These are advantages industrial users of reagent acids, laboratories, colleges and others will welcome as the answer to their special requirements. You will want them, too . . . so order B&A Reagent A. C. S. Acids and Ammonia in this new carboy *now*. Limited shipments soon to all points east of the Rockies.

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FOR AMERICAN INDUSTRY

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In Canada: The Nichols Chemical Company, Limited
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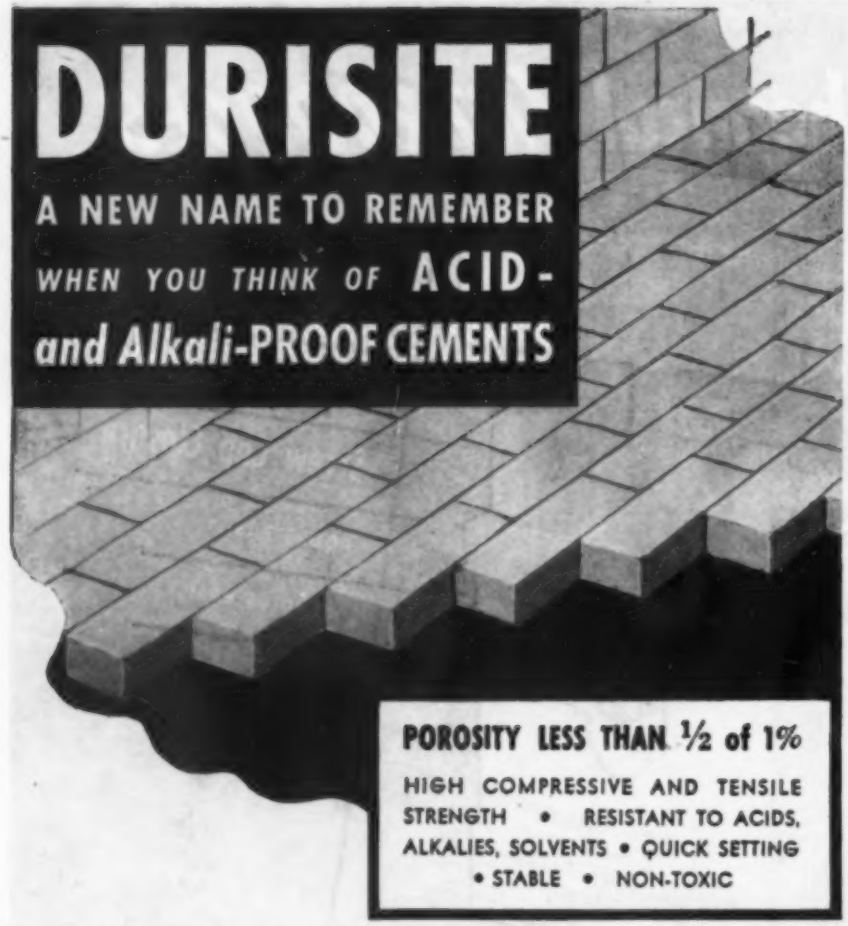
DURISITE

A NEW NAME TO REMEMBER WHEN YOU THINK OF ACID- and Alkali-PROOF CEMENTS



POROSITY LESS THAN ½ of 1%

HIGH COMPRESSIVE AND TENSILE STRENGTH • RESISTANT TO ACIDS, ALKALIES, SOLVENTS • QUICK SETTING • STABLE • NON-TOXIC

Durisite is a resinous cement with important *new* properties. Unlike most resinous cements, it is completely stable in storage. You can carry supplies on hand ready for use when needed. No vexatious delays while orders clear. No costly waste from deterioration in storage. And, unlike most resinous cements, Durisite is non-toxic. Durisite has no dangerous effect on the skin.

Durisite will handle most acids (including hydrofluoric in all concentrations), alkalies of any degree of strength, all oils and solvents, at temperatures up to 350°-375° F. It will handle strong acids and alkalies alternately. Durisite is a cement of unusual strength (compressive and tensile strength is approximately four times that of silicate-type cements). Durisite's dense, non-porous structure is permanent, remaining completely non-absorbent and impermeable even at elevated temperatures.

Durisite is a quick-setting cement. Brick can be laid as fast as the workmen can handle them, course upon course, with no danger of the mortar being squeezed out from the lower courses.

Time proven in extensive laboratory and field tests over a period of three years, Durisite is setting new records for durability in tough acid-*and-alkali*-proof masonry construction.

THE U. S. STONEWARE CO.

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U. S. STONEWARE

Since 1865 *Akron, Ohio*

CONVENTION PAPER ABSTRACTS

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ACRYLIC RESINS

Most startling characteristic of the acrylic resin is its complete transparency, and even if deprived of this asset it would still have a good chance of surviving because of permanence, weather resistance, strength, hardness and ease of machining or hot forming. Given all these characteristics as well, the result is a plastic which in beauty and facility opens many new fields of design and production.

Acrylics should be used correctly. If misapplied, a material receives unjust criticism and it is, after all, simply poor business not to know either the limitations or possibilities of a material. In connection with the fabrication of acrylic plastics it is possible to form objects that are simple and, by that simplicity, very beautiful and entirely functional. They have become widely known for their use in airplanes. Out of this will grow certain uses in which the acrylic resin is better or more beautiful than any other material. In these uses lies the whole future of the material.

There is no optical effect of acrylic resin not also true of all good optical glass. We have now found a material that combines ease of handling and other plastics qualities with these optical properties. Beautiful effects that were too fragile, too difficult or too costly in glass are now easily obtainable in a strong material.

H. F. Pearson, Rohm & Haas, before Society of the Plastics Industry, New York, April 6, 1945.

OUR KNOWLEDGE STOCKPILE

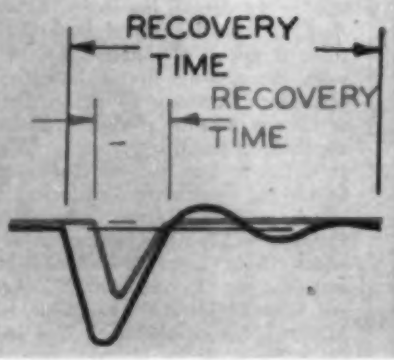
This war—any war—does not add to the stockpile of fundamental knowledge, but instead depletes that stockpile. The spectacular advances made in the art of war are due not to new research, but to the accumulation of knowledge over many generations. While the impact of the war has accelerated many scientific developments to maturity, the new knowledge that made them possible was attributable to an increase of more than 600 percent in industrial research activity in the United States—from approximately 300 industrial research laboratories in 1920 to more than 2,200 in 1940.

Chemistry's greatest wartime achievement was the fabrication of our giant synthetic rubber industry—an industry which will produce approximately one million tons of all types of synthetic rubber this year in the United States. The knowledge upon which this development is based was obtained through research into man-

Only INSTINCTIVE BALANCE *is quick enough*

When you're suddenly thrown off-balance, you have to ACT before you can get around to thinking. Such action is *instinctive*. Because it's instinctive, corrective action begins the instant the disturbance begins and this instinct adds just enough extra-corrective action to restore balance quickly and smoothly to avert further upset. That's INSTINCTIVE BALANCE!

In process control, HYPER-RESET provides balance that is truly instinctive. That's a great deal more than just instrument *alertness* to process disturbance. It's sensing the rate of disturbance at the very outset and instantly initiating not only a standard correction, but an additional correction precisely calculated for the particular process. This extra correction stabilizes the process in as little as one-fourth the usual time.



You can see the difference in recovery time right in stabilization curves of one typical process, below. The compound curve in black represents best possible process stabilization *before* HYPER-RESET. The simple, brief curve in green shows recovery *with* HYPER-RESET in the Foxboro Stabilog Controller.

Although fully satisfactory for some processes, the recovery in curve No. 1 might permit serious upsets in others. The patented HYPER-RESET function in Stabilog Controllers "feels" the requirements of each process, and precisely meets them. Write for detailed discussion. The Foxboro Company, 16 Neponset Avenue, Foxboro, Mass., U. S. A. Branches in principal cities.

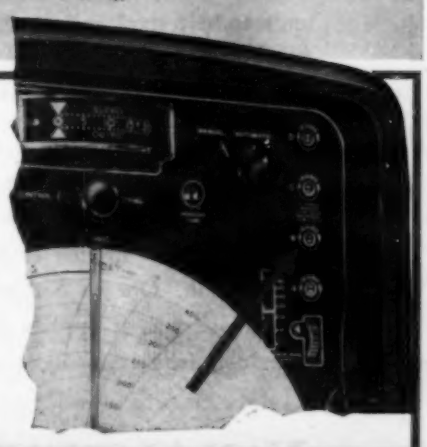
Why HYPER-RESET Saves a Needless, Extra Adjustment

With a HYPER-RESET Stabilog Controller, *only one adjustment* is required for accurate selection of both the reset rate and the rate-sensitive, extra-corrective function.

It has been well established that the response characteristics of a process determine how much correction can be applied, and how fast. It is the time characteristic which determines the reset adjustment, and it is this self-same time characteristic which also establishes the amount of rate-sensitive action required!

Both research and field experience have demonstrated that the rate-sensitive adjustment, as well as the reset, must be matched to the process; and that a definite relationship exists between any given reset value and the corresponding rate-sensitive value for best recovery.

These two values are combined as a *single adjustment* in the Foxboro HYPER-RESET Stabilog Controller.



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Is Your

CAPITAL STRUCTURE

Outdated?

IN THE press of changes wrought by war, conversion and reconversion, it is well to remember that your company's *capital* structure, too, may have been affected by new conditions.

Many a company now has a newly-created opportunity to clear the decks financially for the future—a chance to reduce unnecessarily high coupon rates or preferred stock dividend requirements. Maturity dates, too, which once were satisfactory, may now be awkwardly timed.

As investment bankers with facilities for nationwide distribution of securities, we have frequently been called upon to help modernize a capital structure—and it is our experience that a general improvement of the corporation's overall financial well-being usually results.

If you are an executive of a substantial corporation, and feel that reclassification of securities is desirable for your company, or if you require additional working capital, you are invited to call upon us at any time for consultation. One of our partners will be glad to study the situation as it applies to your organization, and to make definite recommendations.

VAN ALSTYNE, NOEL & CO.

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made rubbers carried on between the two world wars. The wartime synthetic rubber program is not the only outgrowth of this research, for we also will have after the war new rubbers by the hundreds, performing unique and unexpected jobs.

The best insurance policy of freedom is an overflowing reservoir of fundamental new knowledge. Our military opponents have "shot the works" in their desperate struggle for victory, and if we are to sustain our standard of civilization we must give all possible impetus and encouragement to the creative thinkers. There is no such thing as mass production of creative thinking, but such thinking comes from inspiration, which is and can only be the product of free men.

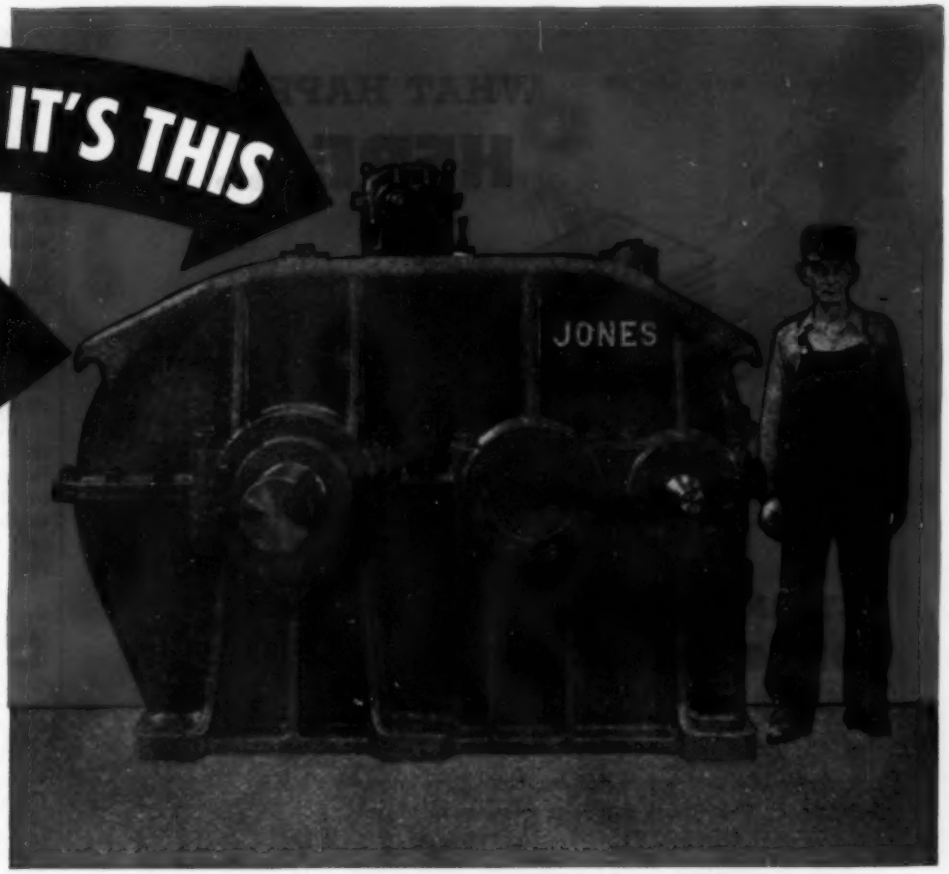
Howard E. Fritz, director of research, The B. F. Goodrich Co., before American Welding Society, Cleveland, May 11, 1945.

PETROLEUM IN THE MIDDLE EAST

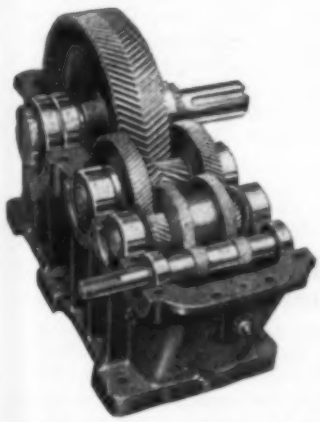
EAST of the Persian Gulf there is a great thickness of Tertiary beds which lie against the foothills of the Zagros Mountains. The total thickness of these horizons may run well over 50,000 feet. They have been faulted and folded and overthrust and the overthrusts have been complicated by the fact that there are thick gypsum and anhydrite beds which have served as lubricating layers for overthrusts and also by the fact that deep down in the section probably arising from Precambrian strata, there are a great number of salt masses. The big producing horizon in this area is the Asmari limestone of Miocene Age. A thousand feet of producing limestone is not at all unusual and in some cases, the oil-water line is down the flank of the structure some 5,000 ft. The fields which are presently producing in this area are those of the Iraq Petroleum Company at Kirkuk in Iraq and the Anglo-Iranian's field in the Transferred Territories at Naft-i-Shah, and in Southern Persia in the Province of Khuzistan, the group of fields which begin with the Maidan-i-Naftun and continue through Haft Kel, Aga Jari and Gach Saran. Of these fields, Kirkuk, Maidan-i-Naftun, Haft Kel, Aga Jari and Gach Saran all lie in the billion barrel class; the largest two are probably Kirkuk and Gach Saran. In addition, heavy oil fields of great magnitude have been found near Mosul. Only a small percentage of the possible structures have been tested in this area.

West of the Persian Gulf, a different geological condition, it has been found by drilling that oil horizons extend well down toward the base of the Mesozoic and that there are immense deposits of oil under the plains west of the Two Rivers and the Persian Gulf. The structures in this area are quite different from those to the East. Relatively gentle folds occur of great size with no overthrust faulting that we yet know. The producing zones are characterized by much thinner sections for while those East of the Gulf frequently exceed 1,000 feet, those West of the Gulf are usually under 500 feet. On the other hand these horizons are very much more porous and the yields per acre will probably be comparable. The most important single field so far discovered West

WHETHER IT'S THIS —OR THIS



. . . both will stand up under war time conditions



The above view of a Jones Triple Reduction Herringbone Speed Reducer is typical of a line that is noted for advanced design, superior materials, precision workmanship.

TWENTY FOUR hours a day operation plus loading up to rated capacity or beyond are testing speed reducers in every type of service.

Jones Herringbone Speed Reducers are establishing remarkable service records under these conditions. One reason of course is the fact that Jones Reducers have always been rated in accordance with the recommended practice of the American Gear Manufacturers Association.

With this conservative rating policy goes sturdiness, compactness, symmetry and balance—all factors that influence maximum efficiency, long life and improved performance.

Jones Herringbone Gear Speed Reducers are built in a wide range of ratios and ratings to cover every requirement. Single (Type SH) reducers in standard ratios range from 1.25 to 1 up to 11 to 1 in ratings from 1.3 to 440 H.P. Double (Type DH) reducers are built in standard ratios from 10.9 to 1 up to 72 to 1 in ratings from 0.5 to 275 H.P. The triple reduction reducers (Type TH) cover a range of ratios from 86.9 to 1 up to 355.8 to 1 in ratings from 0.3 to 78 H.P.

All these reducers have heat treated gears, ground shafts and are mounted with anti-friction bearings throughout. Cast iron bases are available for all variations of motor assembly.

For complete information on both standard and special applications of Jones Herringbone Reducers ask for Catalog No. 70. This 128 page catalog is a comprehensive technical treatise on the whole subject of Herringbone Reducer application for all conditions of service. If you have any type of drive problem that might call for Herringbone gears we shall be pleased to send you a copy.

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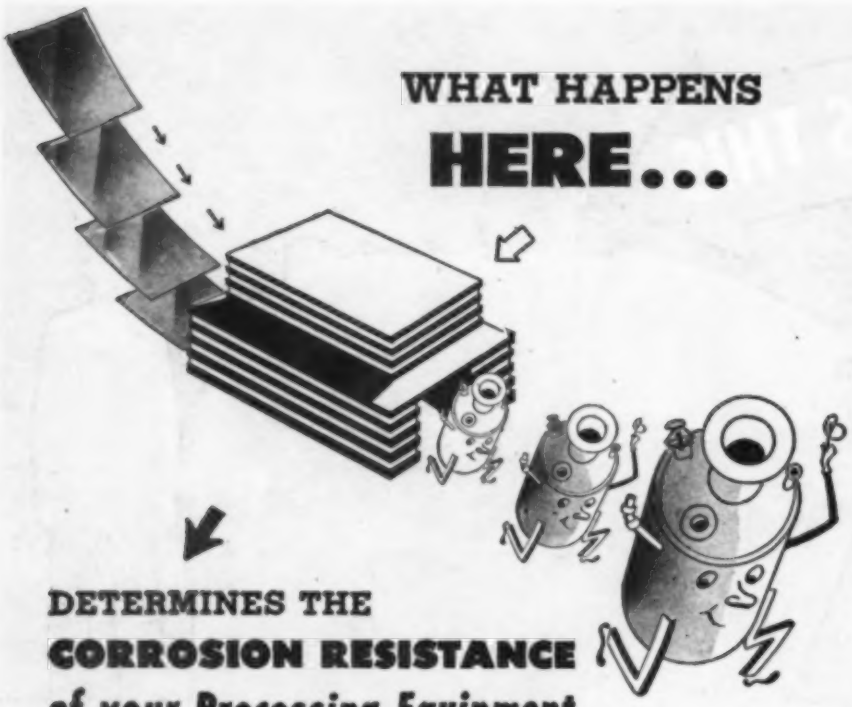

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DETERMINES THE
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It looks simple! A sheet of stainless steel goes into a fabricator's plant, out comes a processing vessel built to specifications.

And, theoretically, if the specifications have been followed, one fabricator can make as good a vessel as another.

But it doesn't work that way. The corrosion resistant alloys present tough problems during fabrication. Unlike carbon steels, they have special properties which must be preserved. Any fabricator can build equipment of metal, but it takes a high degree of specialization to build *alloy* equipment with maximum retention of the original properties.

Strength and corrosion resistance—easier cleaning—lower operating costs—you have a right to demand these qualities in your stainless steel equipment.

For more than 50 years we have been building equipment from corrosion resistant alloys. Our mechanics and engineering staff are trained for this work. Our plant machinery, our tested procedures—have been designed for it. When next you order corrosion resistant equipment, get the extra protection our experience, skill and techniques offer. Consult with us. S. Blickman, Inc., 607 Gregory Ave., Weehawken, New Jersey.

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A request on your letterhead will bring our guide, "What to Look For When You Specify Stainless Steel for Your Processing Equipment."

of the Gulf is Burgan in Kuwait. This is believed to contain some 9,000,000,000 bbl. of oil which probably makes it the world's largest field.

The island of Bahrein is a relatively small field as Persian Gulf fields go for its reserves lie under 500,000,000. Across the Gulf of Selwa from Bahrein is the Dukhan field in the Shaikdom of Qatar which it is believed will be a billion barrel field. All these fields in the Persian Gulf have been discovered with less than 150 wildcats. Available proved oil in the Persian Gulf is already over 25,000,000,000 bbl. and the amounts will be doubled without any great effort on the part of companies.

All of the fields produce sulphur bearing crude, usually making by direct distillation, gasoline with relatively low octane number and excellent Diesel oils. The sulphur ranges upward from 2 to 5 percent. The fields at present producing produce light oil of over 30 gravity.

An estimate of the world's reserves showed that approximately 45 percent of the proved reserves of the world are now concentrated in the Near East. It is interesting to note too that these enormous reserves have been discovered in countries which have been poor for a great many generations. The discovery of these immense quantities of oil will add greatly to the riches of these countries and will provide the wealth for the reconstruction of the great irrigation works and roads, to make them again one of the fertile places of the world. At the same time, the reserves themselves guarantee to the world that nobody will want for petroleum in the next generation and that there is, therefore, little excuse for international bitterness and rivalry to arise with respect to oil supply.

James T. Duce, Arabian American Oil Co., before California Section, American Chemical Society, Berkeley, March 16, 1945.

PETROLEUM NOW AND TOMORROW

THE OIL industry in this country is now producing and refining about 1,000,000 bbl. per day more than it did in 1942. The military has taken all of the increase and another 700,000 barrels per day which has been squeezed out of the civilian economy. Only a vigorous domestic industry would have made such accomplishments even remotely possible. Consumption of aviation gasoline is today more than 100 times as great as at the peak of the last war, and that of motor gasoline is about nineteen times as great.

The allied forces need all the gasoline and other oil products they can get. Afterward, in spite of the laudable ambition of the military to "hurl everything but the kitchen sink" in Japan's direction, the limitations of transport will inevitably leave more gasoline and other products in this country. It will take time to build up the forces and facilities to utilize anything like the tremendous quantities of aviation and motor gasoline which are being consumed in Europe.

Plans are already made to take the "cream" out of the 100 octane gasoline now used in military planes and make a super-fuel to give American planes super

Number 10 of a Series: **"Looking at the 5 essential things you never see in anodes!"**

Unforgettable EXPERIENCES!

ADDED TOGETHER, the working years of a faithful group of 369 National Carbon Company employees exceed 70 *centuries* of unforgettable experiences! *And unforgotten manufacturing experience* . . . with "Acheson" anodes for the Nation's electrolytic cells. These loyal workers have been associated with us from 15 to 35 years each.

Now in its 60th year, National Carbon looks at the record of this group and of the many hundred others who have contributed so much to its history.

Some have improved plant machinery, or perfected its use. Others have developed new formulas to reduce anode usage costs, or to lower average voltage. Still others have helped customers use anodes more effectively, or have made suggestions to increase electrolytic production of caustic soda, chlorine, chlorates, and other indispensable materials.

We truly believe that this unmatched manufacturing experience, extending over six decades, is of utmost importance to the quality of electrolytic-cell anodes . . . one of "the five essential things you never see" in them but which are basic to our products. The other "unseen" essentials are: Selection of raw materials, manufacturing control, customer service, and continuing research. Your inquiries are cordially invited through our nearest Division Office.

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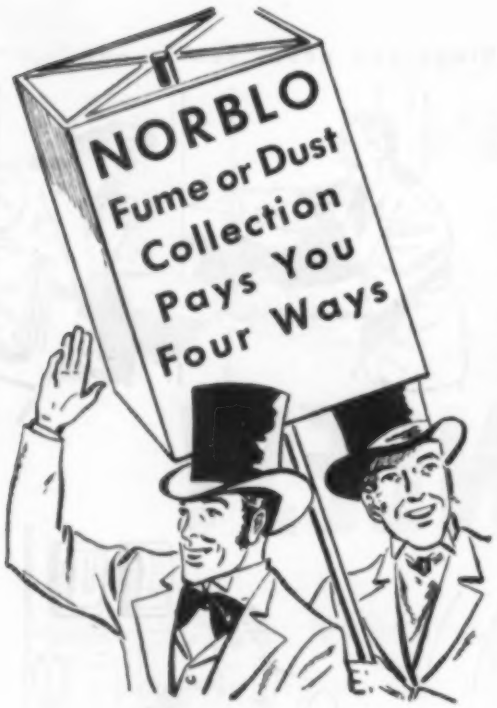
KEEP YOUR EYE ON THE INFANTRY . . . THE DOUGHBOY DOES IT!



● Low-cost fume or dust collection in the smelting, rock products and chemical industries calls for Norblo automatic bag type equipment. As part of a production process — as it is in zinc and lead fume collection — or as salvage of valuable materials, Norblo high efficiency in continuous operations soon pays for the equipment directly. Low maintenance and economy of power plus advanced design and freedom from obsolescence are added low-cost factors worth looking into.

Norblo equipment includes centrifugal and hydraulic types. Where a combination of two or more types is more efficient or more profitable to you, Norblo engineers will say so. And where Norblo designs the complete installation, performance is guaranteed. Tell us your problem — or write for descriptive folders to help you survey your needs.

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MAGNETIC LEVER VALVES

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General Controls' K-10 has six times more powerful lever action than ordinary solenoid valves. The tight seating feature provides positive opening and complete shut-off. Quiet, two-wire, current failure, packless construction. Designed for normally closed or open; AC or DC up to 1¼" I.P.S.; port sizes to ⅝". Available for pressures to 1,000 lbs. Request Catalog.

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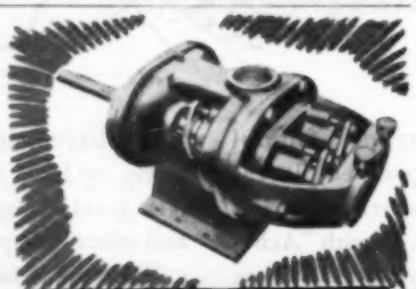

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Positive displacement at any speed or pressure, Bump Pumps are self-priming under high vacuums or against head pressures . . . can be operated at low speeds . . . no agitation, churning, nor vibration within the pump. Bump Pumps deliver a constant volume per revolution regardless of speed or pressure. Available in capacities from ½ to 400 GPM, and in different models, variable speed, V-belt, direct drive and tight and loose pulley models.

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LA CROSSE • WISCONSIN

performance. The less valuable constituents left over will go into motor gasoline and so increase the supply of that commodity available.

There are some contentions that it would be unwise to relax restrictions on rationing promptly after the end of the European war because of the critical situation in tires and spare parts. However, after the troubles experienced in rationing gasoline when it was really short it would not be practical to ration when gasoline becomes plentiful. Prompt relaxation would be desirable along with frank explanation to the people as to when they might expect tires, spare parts and cars, leaving to them the amount of conserving on cars necessary to make them last.

The amount of fuel oils released would be less because of the great need the Navy will have for bunker fuel on the long trips across the Pacific.

Looking ahead to the first postwar year, a slump in gasoline demand owing to shortage of 6,000,000 or 7,000,000 cars as compared with prewar levels. For other products the demand would hold up or increase.

Regarding the long future of petroleum, inaccurate statements are often made in both directions. The number of years' supply of crude reserves has declined only because current consumption has increased so rapidly. The measuring stick has grown longer. Actually the known reserves at the end of 1944 reached a new high of 20,450,000,000 bbl. There were numerous striking instances about 25 years ago in which the early exhaustion of petroleum supplies had been predicted, and total reserves were estimated at 6.5 billion barrels, but the petroleum industry has produced about 25 billion bbl. since then and still had as of today over 20 billion bbl. of proven reserves. This is a modern counterpart of the miracle of the loaves and fishes with "twelve baskets left over."

Technology has played a large part in keeping up the supply of petroleum. Where once 70 to 80 percent of the oil was left in the ground, usually not more than 30 to 40 percent remains today after the pumps have been pulled. Heavy oils are being converted into lighter and more valuable products. The day of burning fuel oil in direct price competition with coal is about over. Higher octane gasolines will lead to development of more efficient engines and cut down the amount of fuel they will need.

Despite all improvements in methods of finding and producing oil, the returns on effort are diminishing. But the petroleum industry has no fear of actual exhaustion of its raw material, because oil can be made from natural gas, coal, and shale. Just over the horizon is the making of gasoline from natural gas by what is known as the Fischer Tropsch process. The cost will not be much greater than at present, and large quantities of gas are available despite the fact that much of the supply has been earmarked for public utility use.

From lignite and coal the Germans have been obtaining a large share of their gasoline. If and when we need to do so, we can follow suit in this country at costs probably not more than 5c. per gal.

A War Time "Must" -a Peace Time Need

DURING the past several months we've been telling you how "Automatic" FIRE-FOG licks really tough fires, particularly those originating in oils or other flammable liquids. Now, with censorship wraps off, here's the protection FIRE-FOG offers in the manufacture of munitions of war:

One of the largest powder plants in this country is at present producing tons of the new Rocket Powder under the protection of "Automatic" FIRE-FOG systems. One division of this factory alone averages 185 fires each day —over 5,000 fires every month! "Automatic" FIRE-FOG systems of protection put a torrent of water on these blazes within a half second of their inception, usually extinguishing them within five seconds. Most important, there are no injuries, no machinery damage, and often much of the powder remains unburned. Production at the powder rolling machines is restored within a matter of minutes.

All this has been made possible through the close cooperation of the powder manufacturer and "Automatic" engineers . . . *just the sort of cooperation between your staff and "Automatic" engineers that will result in licking your toughest fire problems in the peace time products of tomorrow . . . and TODAY.*

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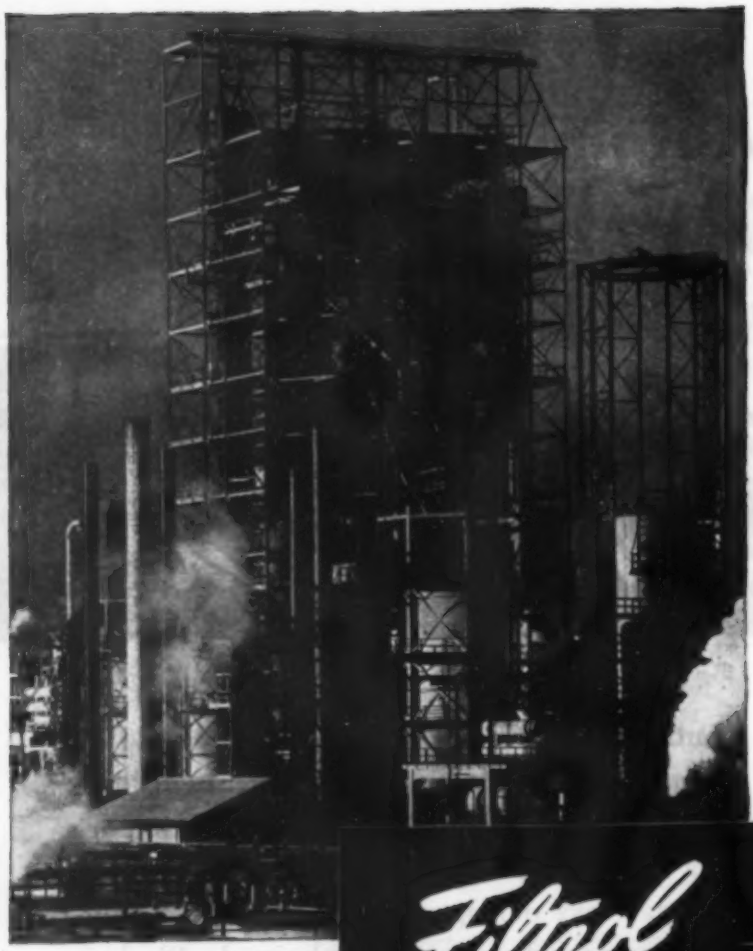
"Automatic" manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Listed by Underwriters' Laboratories, approved by Factory Mutual Laboratories.



THE GREAT NEW RICHFIELD CRACKING PLANT AND SCORES OF OTHERS GO "ON STREAM" WITH

Filtrol Catalysts

American technical ingenuity is again exemplified in the great new petroleum cracking plants going "on stream," producing the superior fuel that is having such telling effect on our far-flung battle fronts.

Filtrol is proud of its "partnership" in this great American effort that has produced the victory-making, vital 100 octane-plus gasoline.

Through ardent research – through many years of successful commercial experience – Filtrol Catalysts are keeping pace with the outstanding technical developments in petroleum refining for war.

Postwar catalysts must be flexible for product distribution changes to meet peacetime refinery balances and specifications. Filtrol Catalysts have this flexibility.

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PRODUCTS OF FILTROL RESEARCH AND DEVELOPMENT

higher than at present. Abundant tar sands, mainly in Canada, and oil shales in the western United States, are also sure sources of oil if needed. There is nothing in sight which would jeopardize our position as a "nation on wheels."

In order to delay the day of turning to these new sources and paying higher prices it will probably be necessary to increase reliance on foreign sources of petroleum. A country that has only about 15 percent of the land area favorable for oil accumulation and only about 35 percent of the known petroleum reserves cannot expect to produce indefinitely 65 percent of the world's oil. Oil from the rich fields of the Middle East will flow increasingly into Europe. This will back up Venezuelan oil in the western hemisphere and make it available to this country.

The sound thing to do would be to keep enough oil coming in so that there will be no lack for transportation or industrial needs, but not so much as to prevent domestic crude prices from being high enough to keep our geologists and drillers hunting for oil and our chemical engineers interested in development of substitute sources of oil. As this war has abundantly proved, only a strong and vigorous domestic industry can be relied upon in a real war emergency.

If we permit impractical theorists to hypnotize our nation into an act of national hara-kiri, all of us will suffer. The only thing that can prevent our country from having abundant liquid fuel for many generations at reasonable prices is interference with the free play of technology and competitive enterprise.

R. E. Wilson, Standard Oil Co. of Indiana, before Chicago Economic Club, March 2, 1945.

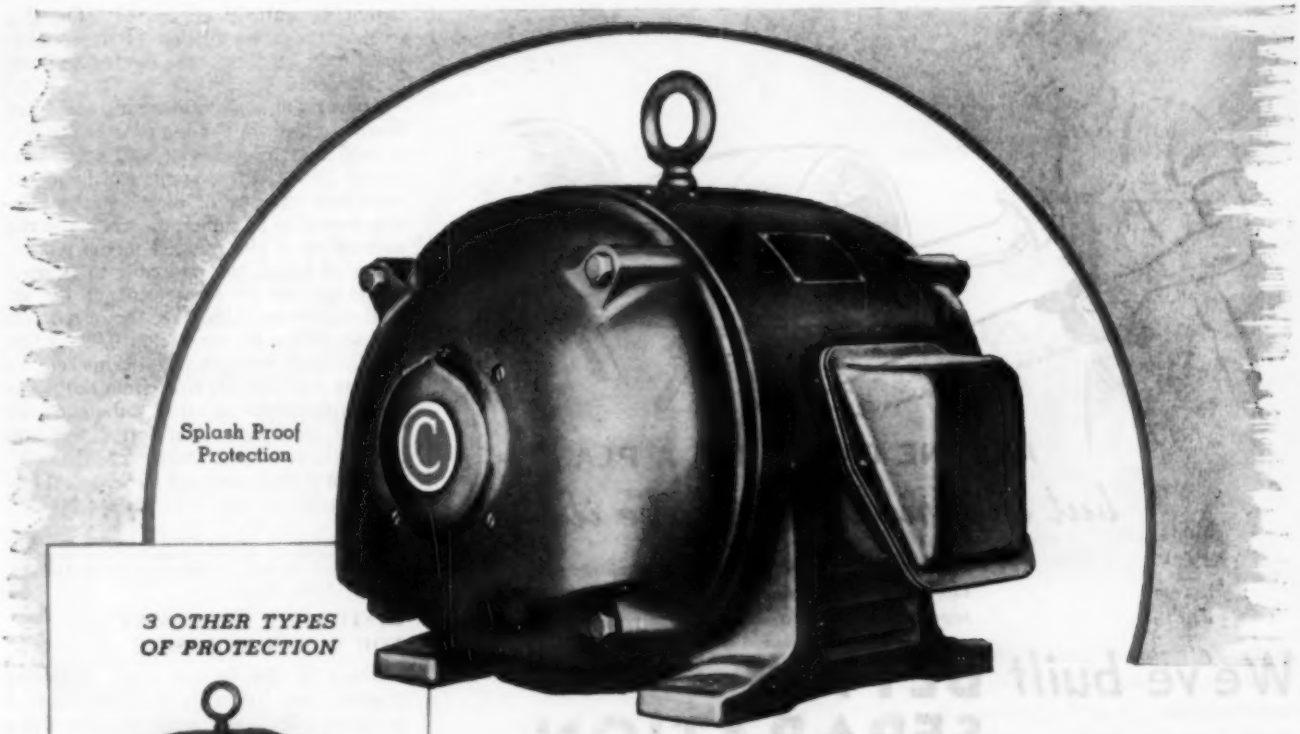
EXTRACTION OF PURE COBALT BY ELECTROLYSIS

A SIGNIFICANT proportion of cobalt supplied to industry must be available in metallic form. The chemical methods of purification currently applied, under factory conditions, yield cobalt oxide containing 1 to 1.5 percent Ni and also small quantities of Fe and Cu. In the pyrometallurigcal treatment of cobalt oxides, the possibility of introducing impurities such as sulphur, carbon, and additional iron into the metal is not excluded moreover, the retention of appreciable quantities of cobalt in the slag is unavoidable in view of rigorous specifications for the purity of the metal.

Accordingly, the electrolytic production of cobalt from the the oxides, with a minimum of pyrometallurgical treatment, appears extremely attractive. The removal of lead and iron as impurities in the electrolyte presents no great difficulties, but the elimination of nickel from the electrolyte is much more complicated.

Starting with a crude cobalt oxide cake, this is converted into cobalt sulphate and electrolyzed in a diaphragm cell, using duriron anodes. Catholyte and anolyte are separately circulated and regenerated. Excess iron in the anolyte is removed by soda ash.

Principal factor affecting the purity of the cathode deposit is the increase in the acidity of the electrolyte. However, under optimum conditions, the cathode deposition of some nickel along with the cobalt



Splash Proof Protection

3 OTHER TYPES OF PROTECTION

Form J — General Purpose Application

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Century Explosion Proof Motor

Where There Are Splashing Liquids

Guard Against Production Losses With CENTURY SPLASH PROOF MOTORS

Whether yours as an installation is subjected to splashing liquids — or whether your electric motors must withstand plant washdowns — Century Splash Proof motors will give you protection.

Of course, any falling solids are also kept out of the operating parts of the motor by Century's proven splash proof construction.

Special insulation is available for higher concentrations of acids and alkalies.

Wherever your electric motors must operate in conditions such as these, for safety's sake, specify Century Splash Proof. A Century engineer will be glad to give you complete details about the advantages of Century motors as they apply to your job.

Century C MOTORS

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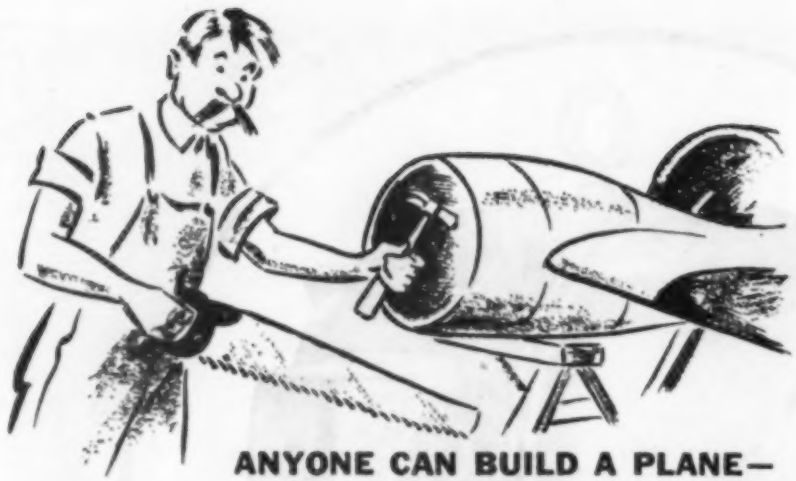

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but the trick is to make it fly

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cannot be entirely eliminated. On this account the accumulation of appreciable quantities of nickel in the electrolyte must be avoided.

After trying out various methods, we finally decided on the use of a suspension of solid dimethylglyoxime. A 25 percent excess of this reagent over the stoichiometric equivalent quantity of nickel in the solution proved to be sufficient. Owing to the reversibility of the reaction in the precipitation of nickel, we were able to recover, for re-use, up to 80 percent of the dimethylglyoxime added to the electrolyte and so reduce its expense to 0.99 kg./kg. of Ni. After precipitating the nickel, the solution was carefully freed from the excess dimethylglyoxime by active carbon and the purified electrolyte then introduced into the cathode compartment of the cell. Cathode deposit analyzed 99.9 percent Co, 0.02 percent Fe and 0.05 percent Ni.

N. Fedotov, Leningrad Chemico-Technical Institute, paper prepared for presentation before The Electrochemical Society, April 12-14, 1945.

DISTILLERY PROCESSES FOR CUBAN MOLASSES

Cuba is the largest sugar producing country and has a large production of molasses. It is not what you are doing at present nor what can be done in a few years from now but what are you going to do after the war stops. It is misleading to merely state that the inefficient plants erected under the stress of war should be shut down and that the more efficient ones will be able to maintain their prewar status. Cuba's problem is not industrial or agricultural, but is both.

The first question we may justly ask is shall Cuba revert to its prewar status, use a limited quantity of blackstrap molasses for the manufacture of motor fuel and beverage alcohol and import the surplus blackstrap molasses plus additional invert mainly to the United States?

What are the future possibilities for molasses in the United States? We hear a great deal about synthetic alcohol and very little about other products which gave serious competition to molasses alcohol in the past and will continue to give more in the future.

Competitive products which should be considered are isopropyl alcohol, glycol, and to a lesser extent, methanol. Quantities produced before the war as well as now, and the potential plant capacities do not augur a very encouraging picture for molasses alcohol. The enormous increases in the production of the various petroleum products is a very serious threat not only to the distillers in the United States but also to the Cuban molasses producers. We must bear in mind that synthetic alcohol of 190 proof can be manufactured at a profit at 15c. and the present price set by the government is 26c. per gal. against 48c. per gal. obtained from molasses.

When speaking of yeast, usually we have two products in mind, bakers' and brewers' yeast. During the last few years a third kind of yeast has been marketed, same being manufactured in the molasses distilleries. A process can be installed in any of the existing distilleries. Its advantage is not only the recovery of yeast but also an increased yield of alcohol; a higher per-

ALOYCO VALVES

STAINLESS STEEL

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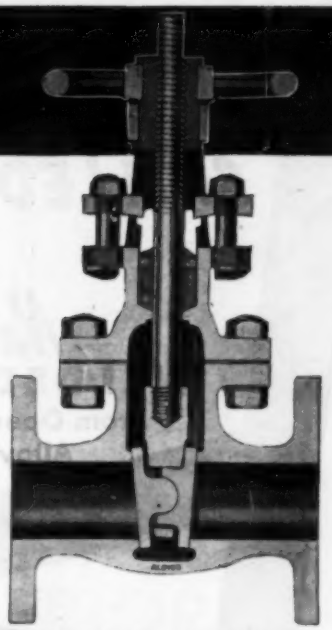
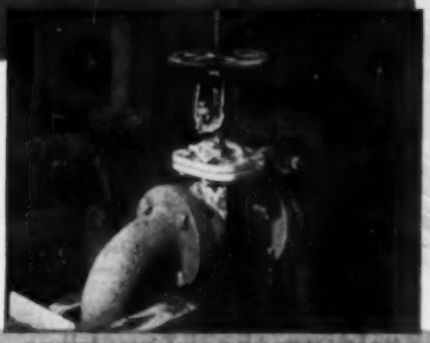
Long wear, rare repair—that's the record of the No. 111 Aloyco Gate Valves in the contact acid department of the American Cyanamid Corporation, Warner Plant, Linden, New Jersey. These valves are made of Aloyco 20, a low carbon, high nickel-chrome alloy also containing molybdenum and copper. The excellent resistance of this alloy to sulphuric and mixed acid over a wide range of temperatures and concentrations proves ideal here.



No. 111's non-fouling double disc wedge provides drop-tight closure necessary in acid handling. Free to rotate, shears through sludge. Bolted bonnets allow easy access for quick cleaning.

THREE YEARS WITHOUT REPAIR
17% H_2SO_4—83% HNO_3

This Aloyco Valve has been handling mixed acid for 3 years. Lead safety jacket removed for photo indicates highly corrosive nature of acids.



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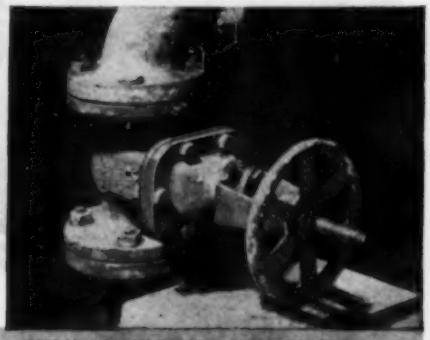
Sulphuric that is two ways hot doesn't come too hot for this Aloyco that replaced competitor one and a half years ago.



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centage of alcohol in the beer and as well as cleaner stills and evaporators. Molasses is diluted with hot water to about 45° Brix, the temperature raised to 180-200 deg. F. To this hot liquid is added sufficient sulphuric acid, so that it not only inverts the sucrose but combines with the lime (CaO) to form calcium sulphate (gypsum). After holding this mixture in a reactor for a predetermined time, depending upon the lime content, calcium sulphate separates out as a fine precipitate which is removed in solid basket centrifugals. The calcium sulfphate after washing is either run into the sewer or used for fertilizer purposes. The clear molasses from the centrifugals is cooled, diluted with water, yeast added and fermented. After fermentation, the beer, containing a pure yeast, is pumped to De Laval separators where the yeast is separated from the beer, washed, recentrifuged and then dried. The clear beer is now pumped either to the beer still or multiple effect evaporator.

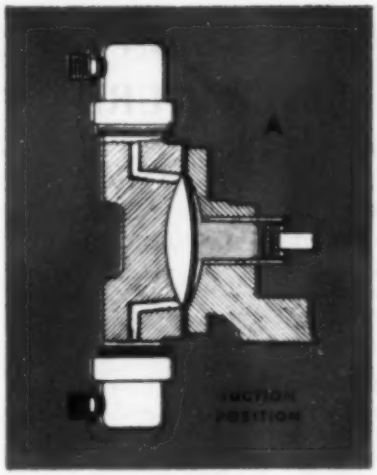
This yeast has never been obtained before in distilleries. Previously it had an ash content of about 65 percent and the yeast was about 25-72 percent. According to the process yeast is obtained which is at least equal to brewers' yeast.

Molasses contains about 3.5 percent of potash (K_2O) or 70 lb. per ton. Also 0.4 percent of organic nitrogen or 8 lb. per ton. Therefore, their recovery should be considered quite seriously. A distillery producing 10,000 gal. of alcohol daily, processing 25,000 gal. of molasses runs into the sewer per year (300 days) 3,150,000 lb. of K_2O and 240,000 lb. of organic nitrogen. The recovery of these values can be accomplished in several ways. First by charring the concentrated stillage and shipping the final product as a non-hygroscopic carbonaceous potash product. Other possibilities are to take the filter press cake and if advisable extract the gums first with alcohol or other solvents and then mix the residual product containing phosphoric acid (P_2O_5) with the concentrated stillage which is high in potash, organic nitrogen and organic matter, thus producing a complete fertilizer.

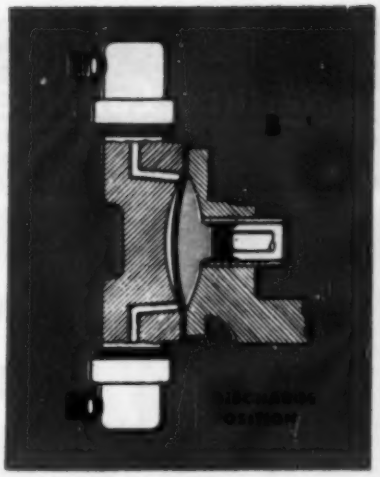
Besides yeast, fertilizer, decolorizing carbon and potash, another pure product is obtained during the fermentation of molasses, namely, carbon dioxide. This product is produced practically pound for pound with ethyl alcohol. It has a purity of 99.8-99.9 percent and after deodorizing is, up to the present time, the cheapest source for the manufacture of dry ice.

The uncertain future of molasses alcohol which must be prepared to meet the serious competition of synthetic alcohol which can be manufactured for 14c. per gal., would mean a price for molasses of less than 5c. per gal. Therefore the question arises, how can Cuba avoid another depression in the molasses market? In addition to alcohol, values can be recovered from molasses by the manufacture of yeast, fertilizer, decolorizing carbon, potash and dry ice and saving in the cost of manufacture by the simultaneous distillation of the beer and concentration of the stillage.

G. T. Reich, Pennsylvania Sugar Co., before Cuban National Congress of Engineers, Havana, April 5, 1945.



HYDRAULIC BALANCE in chemical proportioning pumps is exclusive with Wilson Pulsafeeders. The piston reciprocates a liquid medium interposed between the diaphragm and piston. This causes the diaphragm to react positively to every change in piston position. These diagrams are exaggerated to show piston-diaphragm action at minimum and maximum of the strokes. Actually the diaphragm-travel in small machines is barely perceptible. From a mechanical point of view diaphragm life is infinite.



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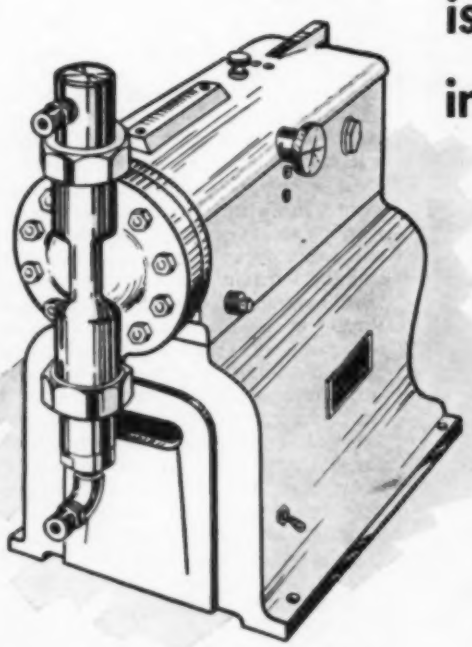
is the key to SUPERIORITY in WILSON PULSAFEEDERS

(CHEMICAL PROPORTIONING PUMPS)



WRITE FOR WILSON BULLETIN D-1144

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FOREIGN LITERATURE ABSTRACTS

PLASTICIZERS AND SOLVENTS FOR POLYVINYL CHLORIDE

ALTHOUGH polyvinyl chloride is considered difficult to plasticize and dissolve, Delorme and Bluma have shown that it can be dissolved and plasticized by a large number of organic products and that the phenomenon of plastification can be explained in a perfectly scientific manner. Their new method for characterization of solvents and plasticizers is based on abnormalities in measurements of viscosity of dispersions of polyvinyl chloride in given solvents and plasticizers at given temperatures. The following facts make it possible to determine beforehand whether a given compound is suitable as a solvent or plasticizer for polyvinyl chloride: (1) Quantity of polyvinyl chloride dissolved in an organic solvent or plasticizer is influenced very little by the duration of contact. (2) Specific viscosity of true solutions at a given temperature increases with the concentration of the solute. (3) If the dispersions were true solutions of spherical macromolecules, the viscosity would be constant, or almost constant, at all temperatures. In the case of linear molecules, the specific viscosity decreases, for constant concentration, with increase in temperature, and the different values of those specific viscosities appear on a graph as practically straight or slightly curved lines. (4) Commercial polymers with a polyvinyl chloride base are not absolutely linear polymers, but frequently have transverse points in the structure of their molecule, so that their behavior is intermediate between that of the spherical molecules and that of the linear ones. (5) Dispersions of polyvinyl chloride are frequently gels and not true solutions, so that their specific viscosities are sometimes higher than those normally found. (6) The value of the specific viscosity of a true solution of a macromolecular substance varies with the nature of the solvent or plasticizer, that is, if the molecular weight of the solute is to be determined by the formula $\eta/c = KM$ (η is the specific viscosity or the molar concentration per liter, M the molar weight and K the characteristic constant of the solvent), K should be given a different value for each particular case.

Digest from "New Method for the Evalution of the Plasticizers and Solvents for Polyvinyl Chloride" by J. Delorme and R. Bluma, *Plastiques* **2**, 80–86, 1944. (Published in France.)

ALUMINUM-ZINC-LITHIUM ALLOYS

MORE work has been done on lithium-containing alloys during 1931-1941 than in all preceding years. Addition of several hundredths of a percent of lithium has a very favorable effect on copper, and aluminum alloys containing zinc and lithium have properties which compare very favorably with those of soft steels. Aluminum-zinc alloys suffered such rapid decrease in strength with increase in temperature and were so susceptible to corrosion that they

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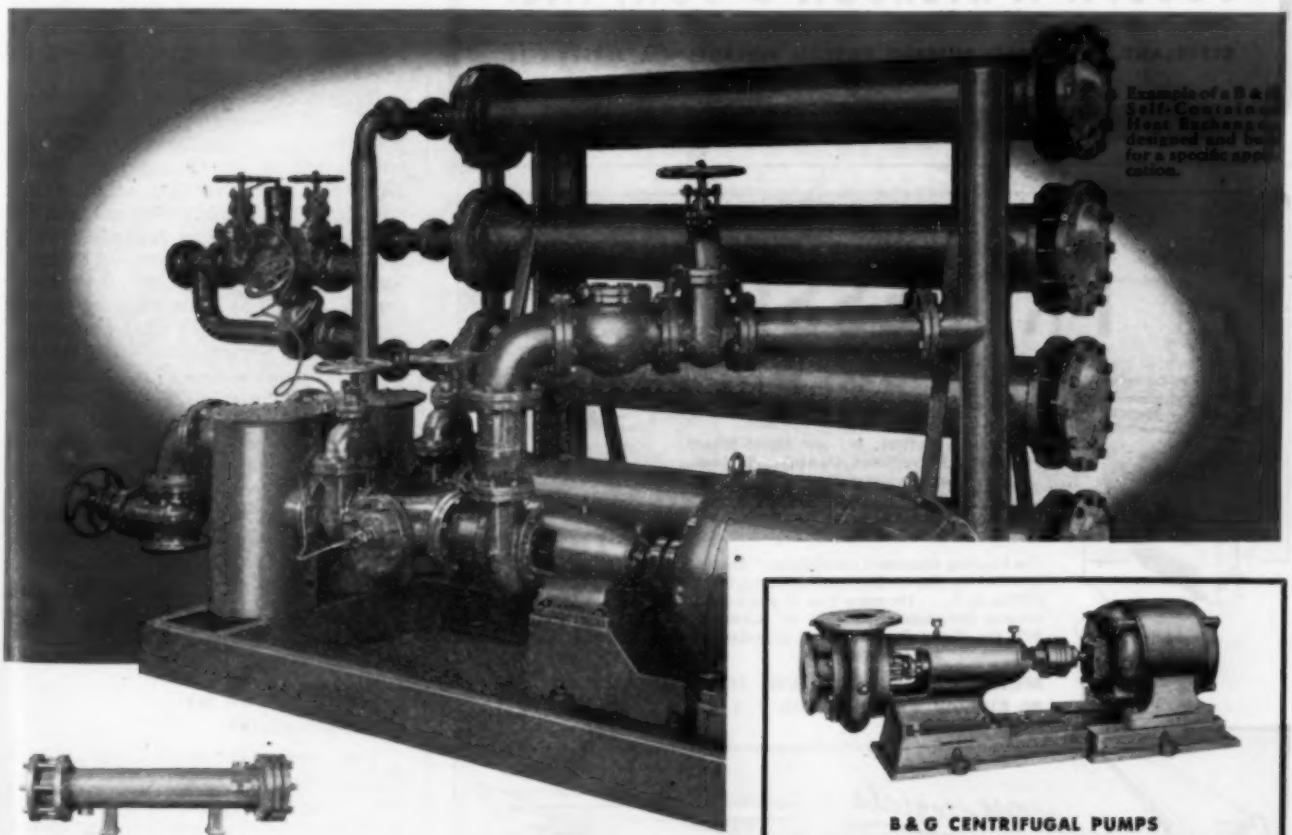

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were displaced by aluminum-copper and aluminum-silicon alloys. They continued to attract attention, however, due to their simple technology, good mechanical properties, and the ready availability of zinc. Work was therefore done by Badaeva and Shamray on the mechanical properties and resistance to corrosion of alloys of aluminum with varying proportions of Zn and Li.

Rolled aluminum-zinc-lithium alloys have good mechanical properties after thermal treatment, some in increased plasticity, others in strength. An alloy with 11.89 percent zinc and 0.11 percent lithium in the annealed state has an elongation of $\delta\ \% = 33.5\%$, a temporary resistance to rupture of $\sigma_b = 20$ kg./sq.mm., a hardness of $H_B = 70$ and an Ericksen index of 8-9 units for a sheet 1mm. thick. An alloy with 5.6 percent zinc and 0.4 percent lithium, with an elongation of $\delta\ \% = 25.7\%$ in the annealed state, a temporary resistance to rupture of $\sigma_b = 10$ kg. per sq.mm., a hardness of $H_B = 31$, an Ericksen index of 9 units, becomes stronger after hardening and natural aging, attaining up to 22 kg. per sq.mm. with a hardness of $H_B = 57$. In alloys with 20-22 percent (zinc and lithium) with 0.19-0.20 percent lithium, the temporary resistance to rupture σ_b reaches 41-43 kg. per sq.mm. with an elongation of $\delta\% = 7\text{-}8\%$ after hardening and artificial aging. The first group of alloys can be used in industry for cold stamping, drawing, and bending, the second for construction work.

Resistance to corrosion of aluminum-zinc-lithium alloys in sea water decreases in proportion to increase of the relative content of lithium up to the proportion of Zn:Li = 4:1, after which it increases as it approaches the aluminum-lithium side. Resistance to corrosion of high-plasticity alloys with 11.89 percent zinc, 0.11 percent lithium and 5.6 percent zinc, 0.4 percent lithium, as well as alloys with 1-4 percent (zinc and lithium) with a lithium content of 0.56-2.24 percent exceeds the stability both of aluminum-zinc alloys in the same range of concentrations, and of duralumin after annealing, hardening and natural aging, and after hardening and artificial aging. The alloy with 5.6 percent zinc and 0.4 percent lithium is not susceptible to corrosion under stress after receiving the above-mentioned three types of thermal treatment.

Digest from "Mechanical Properties of Alloys of Aluminum with Zinc and Lithium" by T. A. Badaeva and F. I. Shamray, *Zhurnal Prikladnoi Khimii* XVI, No. 5–6, 161–172, 1943. (Published in Russia.)

LEAD REFINING BY CHLORINATION

THE SUBSTITUTION reaction $Zn + PbCl_2 \rightleftarrows Pb + ZnCl_2$ is the basic reaction for refining lead by chlorination. A method of physico-chemical analysis was chosen for studying this reaction, specifically that of thermal analysis of the trapezoidal part of the tertiary system Pb-Zn-Cl_2, since this process can be carried out in practice in a wide temperature range, extending in either direction from the temperatures where crystallization first starts in the system. Study of this substitution reaction by thermal analysis showed that the reaction between Zn and $PbCl_2$ proceeds practically completely with formation of metallic lead

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and zinc chloride. Lead can therefore be successfully freed from zinc by the action of gaseous chlorine upon the zinc-containing lead or by passing zinc-containing lead through a molten lead chloride layer. The reaction $PbCl_2 + Zn \rightleftarrows ZnCl_2 + Pb$ proceeds completely from left to right within the temperature range between the temperatures somewhat above the point where the separation of the first crystals takes place and that of their complete solidification. At higher temperatures, apparently, the reaction proceeds partly from right to left. Metallic lead and zinc chloride formed in this reaction do not mix in the molten state, which favors complete separation of the reaction products from each other. In refining lead obtained by the Parkes method zinc is first chlorinated with gaseous chlorine. Use of this process results in pure metallic lead in the bottom and zinc chloride containing a small amount of lead chloride in the upper layer. Zinc chloride can be converted to lead chloride by means of metallic zinc. Pure zinc chloride is obtained in the upper layer and metallic lead in the bottom layer, both of which layers can be completely separated from each other.

Digest from "Study of the Substitution Reaction $Zn + PbCl_2 \rightleftarrows Pb + ZnCl_2$ by Method of Thermal Analysis" by G. G. Urazov and M. A. Sokolova, *Zhurnal Obshchei Khimii* XIV, No. 1-2, 40-56, 1944. (Published in Russia.)

INDUSTRIAL APPLICATION OF ULTRAVIOLET RADIATION

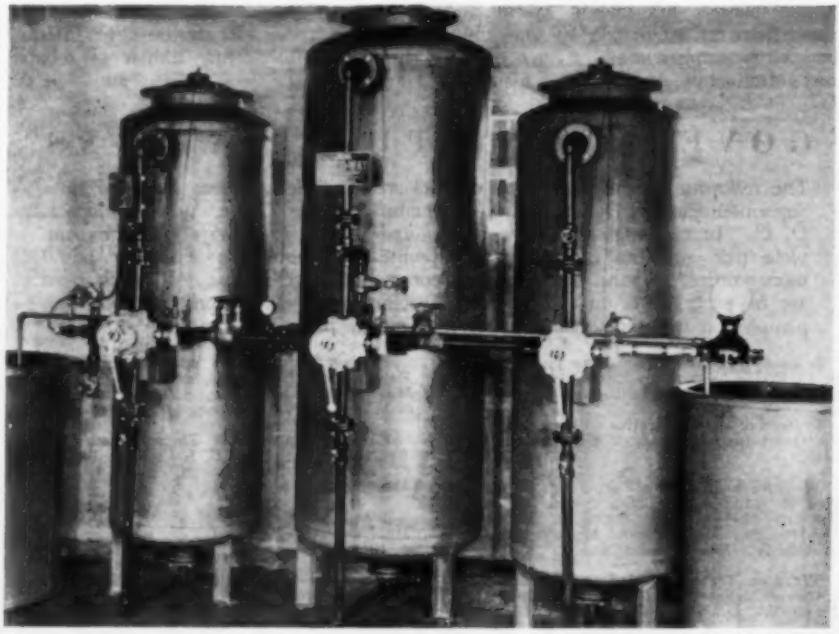
Applications of ultraviolet radiation from mercury lamps fall into three classes: Excitation of fluorescent or phosphorescent products, for carrying out chemical reactions and in treatments of the biological type (artificial sun baths, etc.). The presence of substances which are fluorescent to ultraviolet radiation in certain products such as oils, medicines, etc., can be used in certain cases for detecting adulterations. In the food industry, milk is frequently irradiated to give it greater antirachitic value and to increase its vitamin D content. Ultraviolet rays are also used for the rapid and efficient sterilization of drinking water. An interesting application is for distinguishing live and dead bacteria. When a culture is dyed with acridina yellow, the dead bacteria are much more intensely colored when observed under ultraviolet light.

Daylight can be imitated very efficiently by covering the mercury vapor tubes with a fluorescent substance. Ultraviolet radiation is also used in printing fabrics, when the bath is composed of a dye which must be developed later. Addition of a fluorescent substance, in such cases, makes it possible to detect defects in manufacture and correct them on time. The photocopying industry, especially where papers are used which have been sensitized with diazo compounds and can be developed by ammonia, uses mercury vapor lamps as a source of light. The same source of light can be used for printing photographs without a darkroom. The sensitive surface consists of silver chlorobromide which is not affected by semi-darkness.

Digest from "Industrial Applications of Ultraviolet Radiations" by F. Lauster, *Chem. Ztg.* 66, 403, 1942. (Published in Germany.)

CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor



The process industries use plastics—Saran pipe in a water-treatment unit

PLASTICS REPORT

THE NEW PLASTICS. *By H. R. Simonds and M. H. Bigelow, assisted by J. V. Sherman. Published by D. Van Nostrand Co., New York. 311 pages. Price $4.50.*

THE PLASTICS industry, being in its infancy, is growing and spreading out in every direction so rapidly that it is difficult to keep up with the many changes. Such progress is commendable for the industry, but makes a book on the industry out-of-date by the time it is published.

In this book the authors have attempted to supplement earlier volumes on plastics rather than to prepare a new treatise on the subject as a whole. Yet for those who may not have other books a condensed review of the industry is given in the opening chapter.

Emphasis is on plastic materials developed since 1940, new processes, and new applications for older materials. The authors have also covered the so-called borderline materials, such as synthetic rubbers, organic coatings, and adhesives, which also have developed very rapidly during the war years.

In supplying information on some of the new materials the authors have been under a handicap for much of this information is under government secrecy orders. Unfortunately the need for secrecy has prevented even mention of a few of the plastics and fibers that it is understood have been developed during the past year or two and are now being used in the construction of equipment for the armed forces.

HEURISTIC REASONING

HOW TO SOLVE IT. *By G. Polya. Published by Princeton University Press, Princeton, N. J. 204 pages. Price $2.50.*

FIRST you have to understand the problem. Second, find the connection between the data and the unknown to obtain a plan of the solution. Third, carry out your plan. Fourth, examine the solution obtained. These are the rules of Polya's "system of thinking which can help you solve any problem." The book, which endeavors to understand the process of solving problems, will probably be of considerable interest to mathematicians and problem solvers, of some interest to engineers, and of small interest to those without mathematical training or instincts.

CHEMICAL HISTORY

DISCOVERY OF THE ELEMENTS. *Fifth edition. By Mary Elvira Weeks. Published by Journal of Chemical Education, Easton, Pa. 578 pages. Price $4.*

TODAY we accept without much thought the idea that all matter is composed of ninety-odd elements. But man's thinking had to travel a long road with many obstacles, false starts and wide detours to arrive at this simple idea. The elements, to those ancients who first started theorizing about such things, were: earth, air, water and fire. They were familiar, however, with gold and silver and seven other members of our list. The change from the idea that water is not, but that gold is an element, from the 4 to the 92 (or more) element theory, represents centuries of time and the labor of hundreds of men. It is these men and their labors that made the history which author Weeks has researched out to tell. Some of the stories (phosphorus for example) are more interesting than others, some are more or less familiar (radium), but all are worth reading for the background information they can give us regarding some of our great predecessors and their work.

FIRST REVISION

TEXTBOOK OF ORGANIC CHEMISTRY. *Second edition. By E. Wertheim. Published by The Blakiston Co., Philadelphia. 867 pages. Price $4.*

Reviewed by F. C. Nachod

THE VERY fact that this excellent textbook, after its first appearance in 1939, underwent eight reprintings speaks for the enthusiasm with which it was received by its audience. Now the second edition has come out and while the material has been brought up to date and many innovations were added, all of the features which make the text so attractive have been retained.

One of the nicest characteristics, not commonly found in textbooks, are the numerous portraits and biographical sketches of past and contemporary great chemists. Two new-comers are encountered there: Gustav Egloff and the late Thomas Midgley, Jr.

The reviewer particularly enjoyed two colored plates, illustrating Fisher-Hirshfelder molecular models. Aside from being attractive, they are very instructive and will help the student understand that a structural formula does not just merely consist of letters and connecting dashes.

The only negative comment this reviewer has, is that the nine flow sheets at the end of the book are too small to be really useful. It is to be hoped that a future edition will provide for larger (and

RECENT BOOKS RECEIVED

Advances in Nuclear Chemistry and Theoretical Organic Chemistry. Ed. by R. E. Burk & O. Grummitt. Interscience. $3.50.

Calcium Metallurgy and Technology. By C. L. Mantell & C. Handy. Reinhold. $3.50.

Chemistry for Electroplaters. By C. B. F. Young. Chemical. $4.

Chemistry of Coal Utilization. Ed. by H. H. Lowry. Wiley. $20.

Ebulliometric Measurements. By W. Swietoslawski. Reinhold. $4.

Practical Management Research. By A. R. Wiren & C. Heyel. McGraw-Hill. $2.50.

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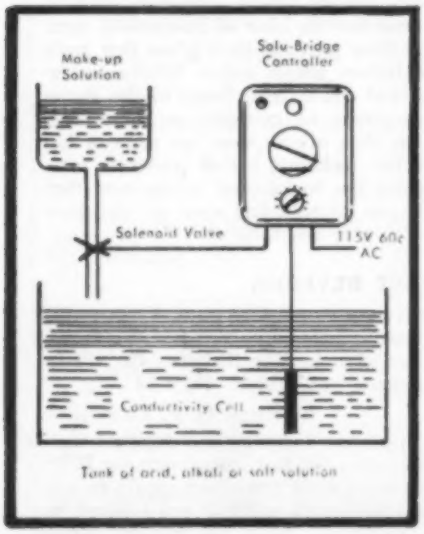

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ACTUAL USES

PLASTICS IN PRACTICE. *By John Sasso and Michael A. Brown, Jr. Published by McGraw-Hill Book Co., New York. 185 pages. Price $4.*

REVERSING the usual method of presenting plastics information, Sasso and Brown have gathered data on some hundred actual applications, but give only a brief introductory description of materials, methods of forming, comparative properties and design considerations. Most of the book is taken up with case studies of commercially produced articles: household appliances, automotive accessories, electrical and radio equipment, toys and novelties, and chemical plant equipment are some of the types of applications discussed. The books deserves to be called "practical" because it tells how and why a particular material was used for a specific application. Plastics producers and molders, as well as designers and fabricators, will find these case histories of interest and value for solving similar or related problems.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publications noted in this list always give the complete title and the issuing office. Remittances should be made by postal money order, coupons, or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, pamphlet is free and should be ordered from the bureau responsible for its issue.

A Second List of Publications on DDT. By R. C. Roark. Bureau of Entomology and Plant Quarantine. E-660. Mimeographed.

Protective and Decorative Coatings. Office of the Quartermaster General. Clothbound. Price $1.25.

Workers in Subjects Pertaining to Agriculture in Land-Grant Colleges and Experiment Stations 1944–45. By Betty T. Richardson. Department of Agriculture. Miscellaneous Publication No. 556. Price 25 cents.

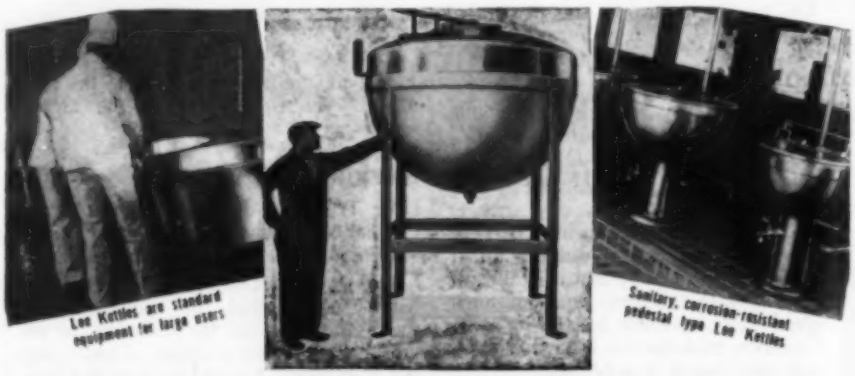
Wartime Technological Developments. Committee on Military Affairs. Subcommittee Monograph No. 2, 79th Congress. Price 50 cents.

Energy Requirements and Equilibria in the Dehydration, Hydrolysis, and Decomposition of Magnesium Chloride. By K. K. Kelley. Bureau of Mines. Technical Paper 676. Price 10 cents.

Fuel for Permissible Flame Safety Lamps. By A. B. Hooker and E. J. Coggeshall. Bureau of Mines. Information Circular I.C. 7301. Mimeographed.

Trends in Exploration of Mineral Deposits. By Lowell B. Moon. Bureau of Mines. Information Circular I.C. 7312. Mimeographed.

Electrolysis of Magnesium into Liquid Cathodes From MgO-Carbon Suspensions in Molten Chlorides. By Burke Cartwright, Lloyd R.



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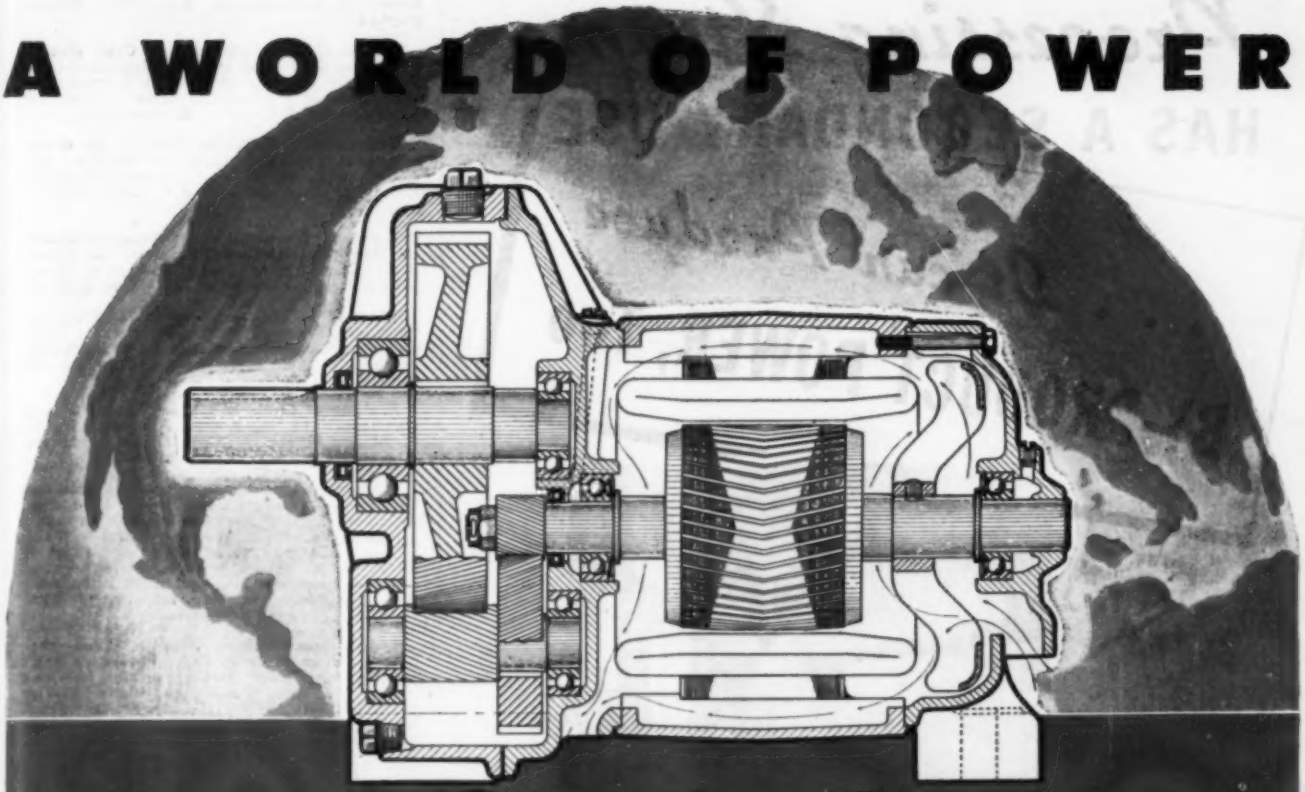

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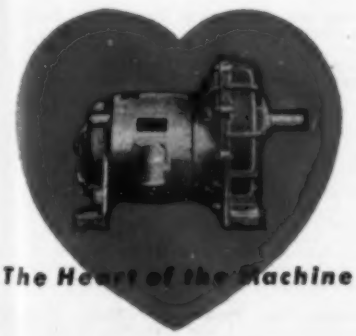

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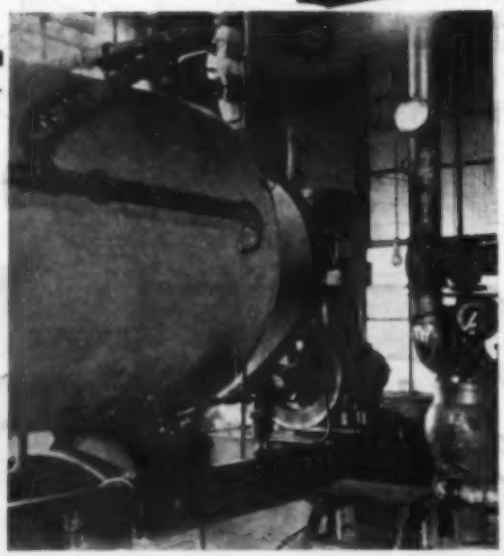

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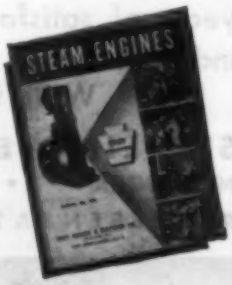

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Michels, and S. F. Ravitz. Bureau of Mines. Report of Investigations R.I. 3805. Mimeographed.

Control of Bulk Densities in Coke Ovens: Studies on Coal Used at Three Byproduct-Coke Plants. By W. S. Landers, L. D. Schmidt, and Wm. Seymour. Bureau of Mines. Report of Investigations R.I. 3807. Mimeographed.

Utilization of Anthracite Fines in the Manufacture of Byproduct Coke. By William Seymour and L. D. Schmidt. Bureau of Mines. Report of Investigations R.I. 3808. Mimeographed.

Trends in Consumption and Prices of Chemical Raw Materials and Fertilizers. By Oliver Bowles and Ethel M. Tucker. Bureau of Mines. Information Circular I.C. 7320. Mimeographed.

Wartime Recommendations for Refinery Inspections. Prepared by Facility Security Division, Petroleum Administration for War. Mimeographed. A code of recommendations for safe operation.

Analyses of Crude Oils From Some Fields of Oklahoma, III. Additional Analyses. By O. C. Blade. Bureau of Mines. Report of Investigations R.I. 3802. Mimeographed.

Future of Light Metals. Record of hearings before Small Business Committee of U. S. Senate on S. Res. 28. About 15 pamphlets forming a part of the hearings record will deal with this subject. The first one of the series is Part 47 of the record. Available to considerable extent from the committee and later to be made available by purchase from Superintendent of Documents at prices not yet determined.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog have been issued on the following items: Insulation, Vermiculite; Block and Pipe Covering (Molded)—HH-I-578a. Detergents, Special; (for Aluminumware, Dishwashing-Machines, and Manual Cleaning)—P-D-236. Soap, Potash-Linseed-Oil; Liquid and Paste (for) Floor and General Cleaning—P-S-603. Ether, Petroleum; Technical-Grade—O-E-751a. Tetrachlorethylene (Perchlorethylene); Technical-Grade—O-T-236. Cupric-Sulfate; Technical-Grade, Crystals—O-C-828. Tape; Rubber (and Synthetic-Rubber), Insulating—HH-T-111b. Insulation (Vegetable or Wood-Fiber); Blanket Felt and Loose-Fill—HH-I-571a. Magnesia; Block, Cement, and Pipe-Covering (Molded)—HH-M-61a. Price 5 Cents each.

RECENT BOOKS & PAMPHLETS

Texas Looks Ahead. Vol. I. Published by The University of Texas, Austin, Tex. 365 pages. Price $1. First of two volumes to be published dealing with the developments in Texas in the postwar period. A comprehensive analysis of resources and a discussion of their uses in the development of the state. Illustrated with tables, charts and maps.

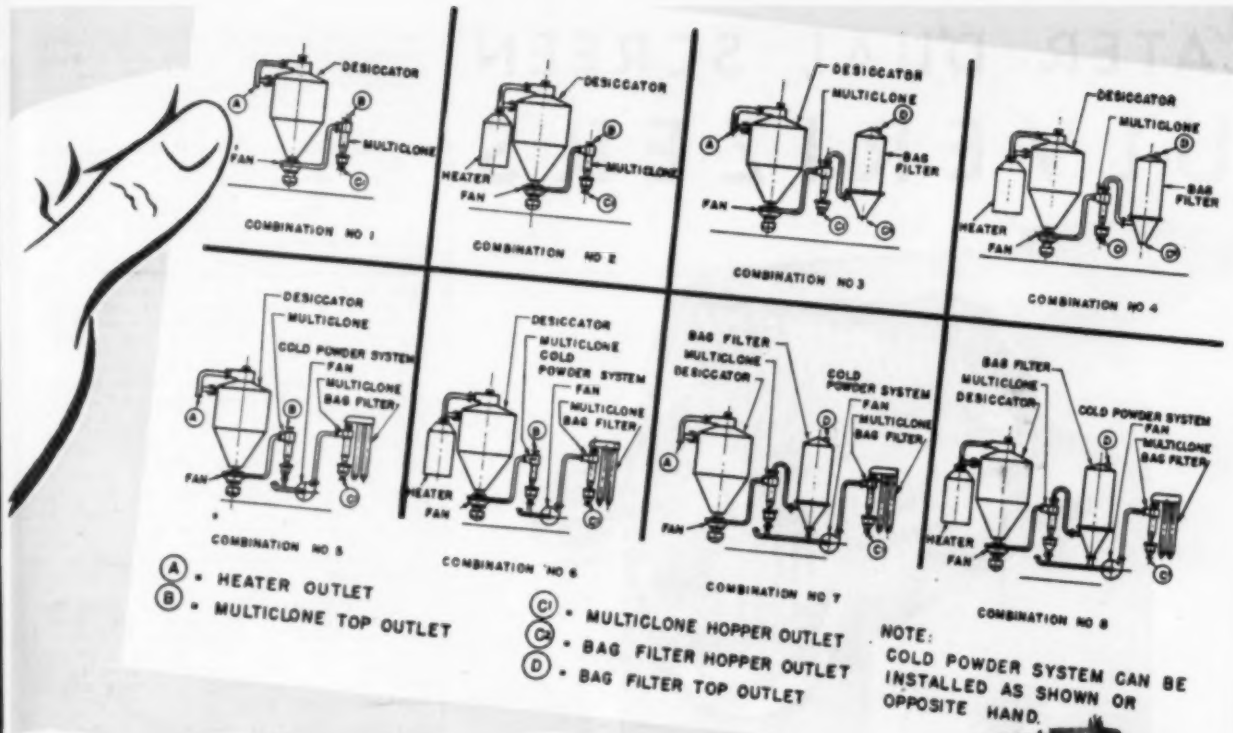
Geology and Manganese Deposits of Northeastern Tennessee. By P. B. King, H. W. Ferguson, L. C. Craig and J. Rodgers. Bulletin 52, published by Division of Geology, Department of Conservation, Nashville, Tenn. 283 pages. Description of manganese deposits, mines, prspects and geological settings. Amplifies three previous reports.

How to Buy and Sell in the British Empire. Published by the World Trade Department, Los Angeles Chamber of Commerce, Los Angeles 15, Calif. Third of a series on world trade that give information on developing import and export business. Cites figures on trade through Los Angeles-Long Beach harbors with some of the countries of the British Empire in the normal years 1936–1940, inclusive.

Planning Pays Profits—The Story of San Diego. Published by the California State Reconstruction and Reemployment Commission, 631 J St., Sacramento, Calif. 32 pages. How San Diego is planning to withstand the impact of wartime changes and to absorb the inevitable shock in the transition to a peacetime economy.

Penicillin—Present-day Concept of Its Clinical Applicability. Published by Commercial Solvents Corp., Pharmaceutical Division, 17 E. 42nd St., New York 17, N. Y. 72 pages. Detailed information and extensive bibliography on the pharmacology and pathology of penicillin. Gives results of clinical investigations.

Trade with Mexico. Compiled by the Industrial and Transportation Department, Los Angeles Chamber of Commerce, Los Angeles, Calif. 18 pages. Mimeographed form listing the commodities, including chemical and related products, entering into the import and



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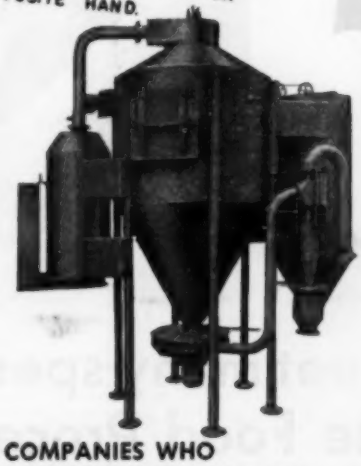

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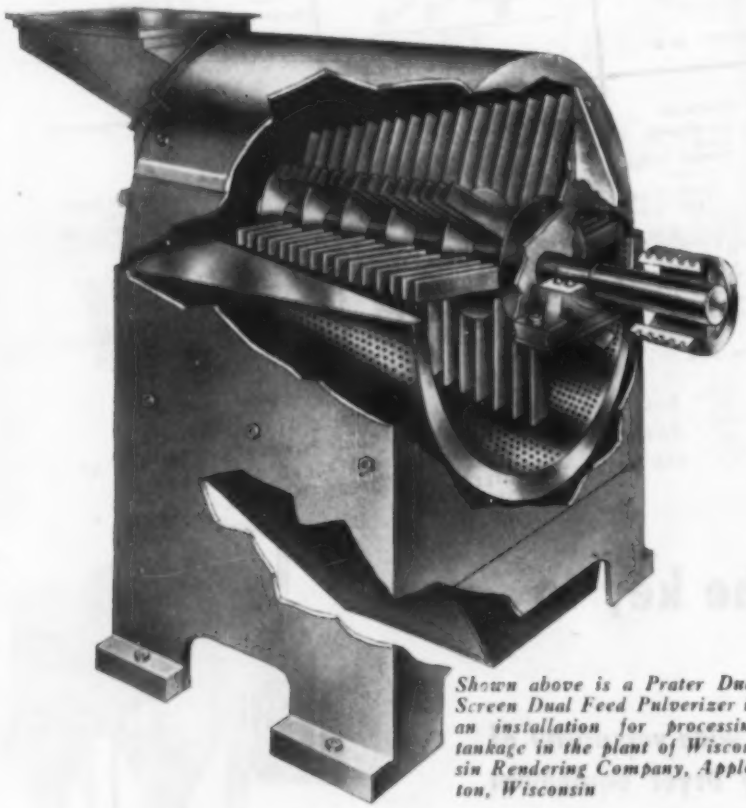

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export trade between Mexico and Los Angeles county. Also lists new and improved commodities produced in Southern California since the outbreak of the war which will be available for postwar trade with Mexico. Includes available figures.

Studies in Redistillation of Carbothermic Magnesium. U. S. Bureau of Mines. R. I. 3806. 53 pages. Mimeographed report giving results of work done under a cooperative agreement between the Bureau of Mines and the State College of Washington, Pullman, Wash. Summarizes developmental work done on processes for distillation of magnesium metal from mixtures produced by the carbothermic reduction of magnesia, evolution of hydrocarbon gases from oil sludge and briquettes produced in carbothermic reduction of magnesia, magnesium sludge briquettes and magnesia-graphite and magnesite refractories.

Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry. Vol. XXVIII. Published by the Society, 56 Victoria St., London, S.W.1. 523 pages. 1943 edition of reports of progress in the chemical process and other related industries.

There Can Be Jobs for All. By M. S. Stewart. Pamphlet No. 104, published by Public Affairs Committee, 30 Rockefeller Plaza, New York 20, N. Y. 31 pages. Price 10 cents. Pamphlet summary of Beveridge's plan for full employment.

The Hydrogenation of Coal at High Temperature. By J. L. Bray and P. W. Morgal. Research Series No. 93, published by Engineering Experiment Station, Purdue University, Lafayette, Ind. 31 pages. Price 15 cents. Report No. 2 summarizing, confirming and extending previous work.

Index to A.S.T.M. Standards. Published by American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa. 197 pages. 1944 edition including tentative standards.

A.S.T.M. Standards on Rubber Products. Published by American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa. 519 pages. Price $2.75. Special compilation of A.S.T.M. standards covering rubber and related materials; includes 75 specifications and tests.

A.S.T.M. Standards on Copper and Copper Alloys. Published by American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa. 444 pages. Price $2.75. 90 standards covering copper and copper alloys, cast and wrought; copper and copper alloys for electrical conductors; non-ferrous metals used in copper alloys. Emergency specifications and alternate provisions applicable to copper and copper alloys.

The Chemist in the Petroleum Industry. By Gustav Egloff, Universal Oil Products Co., Chicago, Ill. 6 pages. Reprinted from *School Science and Mathematics.*

Conversion of Oxygen Derivatives of Hydrocarbons Into Butadiene. By G. Egloff and G. Hulla. 78 pages. Oxygen derivatives of hydrocarbons are readily converted into butadiene by processes that involve one or more stages or units of operation. Reprinted from *Chemical Reviews.*

Army-Navy Contractors Guide for Prime and Subcontractors. Copies obtainable from Readjustment Distribution Center, 6th floor, 90 Church St., New York 7, N. Y. 91 pages. Gratis. An outline for contractors suggesting advance planning methods and illustrating practical procedures for settlement of terminated contracts.

Gas Abstracts. Published by Institute of Gas Technology, 3300 Federal St., Chicago 16, Ill. 21 pages. Vol. I, No. 1 of a new service to the gas industry. Abstracts from more than 130 periodicals received.

Buyers' Guide of the Metal Industries. 1945 edition. Published by American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio. 108 pages. Gratis. Directory of products and their manufacturers, trade names, definitions and reference information.

Geologic Literature of New Mexico Through 1944. By R. L. Bates and M. R. Burks. Bulletin No. 22, published by New Mexico School of Mines, Socorro, N. M. 147 pages. Price 30 cents. In three parts: bibliography of bulletins, articles, papers and reports; index; and list of geologic and other maps.

Polymer Bulletin. Edited by P. M. Doty. Published bimonthly by Interscience Publishers, 215 Fourth Ave., New York 3, N. Y. Price $2.40 per year. Vol. I, No. 1 of a new magazine published in cooperation with the Bureau of High Polymer Research, Polytechnic Institute of Brooklyn.

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MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterheads.

Air Equipment. W. B. Connor Engineering Corp., 112 E. 32nd St., New York 16, N. Y.—4-page illustrated folder describing air-recovery and air pollution control systems.

Bearings. New Departure Division of General Motors Corp., Bristol, Conn.—Bulletin BA. 24-page illustrated booklet describing the fundamentals of bearing application.

Cerium Metal. Cerium Metals Corp., 522 Fifth Ave., New York 18, N. Y.—4-page booklet consisting of two lists of references on the uses of cerium for alloying in conjunction with aluminum and magnesium. These bibliographies have been selected from English, French and German material for the last 20 yr. and important articles are briefly summarized.

Chemicals. Los Angeles Chemical Co., 1960 Santa Fe Avenue, Los Angeles 21, Calif.—56-page booklet listing the line of industrial chemicals manufactured and handled by this firm. Includes a short history of the firm and condensed descriptive and technical information on the firm's line of chemicals used for agriculture, in water treatment, laundry and dry cleaning operations, bleaching clay for the refining of petroleum, animal and vegetable oils, plating and finishing supplies. Illustrated.

Controls. General Controls Co., 801 Allen Ave., Glendale 1, Calif.—30-page service and instruction manual on automatic gas-heating controls. Worthwhile information on installation, operation, and maintenance of the various types of controllers is given.

Diesel Engines. Joshua Hendy Iron Works, Sunnyvale, Calif.—Two publications announcing this concern's new series of marine diesel engines. Publication JHA-11 (16 pages) describes, illustrates and gives technical details on series "50" of 350–675 hp. Publication JHA-9A (8 pages) gives similar information on series "20" of 190–250 hp.

Electric Motors. General Electric Co., Schenectady, N. Y.—Bulletin GEA-4131, 26-page booklet describing and illustrating explosion-proof motors and equipment for use in hazardous locations. Several types of hazardous locations are discussed in detail and information is given on the application of explosion-proof equipment, maintenance and repair, together with engineering data.

Electric Tachometers. General Electric Co., Schenectady, N. Y.—12-page booklet illustrating and describing various electric and photoelectric tachometers for many types of applications. Contains data on specifications, selection and ordering. Bulletin GEA-4324.

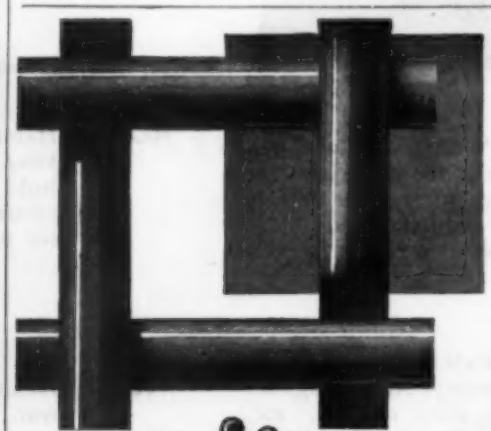
Emulsifier. Asbury Corp., 127 S. Main St., Doylestown, Pa.—4-page illustrated leaflet describing the fluid impactor made by this company for disintegrating, dispersing, homogenizing, and emulsifying solids, liquids and pastes. Construction details, specifications and application information are given.

Equipment. DeLaval Steam Turbine Co., Trenton 2, N. J.—Catalog 1181. 24-page illustrated catalog describing the complete line of steam turbines, helical gears, centrifugal pumps, centrifugal compressors, worm gear speed reducers and oil pumps made by this company.

Fabric Bearings. Gatke Corp., 228 N. La Salle St., Chicago, Ill.—68-page brochure describes performance qualities and applications of molded fabric bearings. Types, sizes and dimensions are included.

Filters. Niagara Filter Corp., 3080 Main St., Buffalo 14, N. Y.—8-page illustrated booklet describing Niagara Filter systems for the chemical, food, fermentation and processing industries. Principle of operation, installation and application information is given.

Flooring. Emery Floor Division, Washing-



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SMALL PARTICLES—*(Light Minerals, Sand, Refractories, Abrasives).* "Buffalo Stainless Steel" Wire cloth in bolting grade. Free bolting. Rustproof. Fast screening with long life in all weather.

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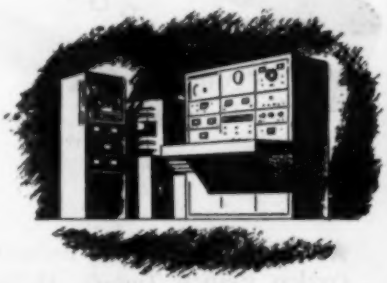
THE MASS SPECTROMETER method of analysis was developed in Consolidated Engineering Company's laboratories over a period of five years. By supplementing the finest equipment with efficient operating techniques and advanced methods of data reduction, the ultimate amount of usable results are obtained.



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HORIZONTAL

AS WELL AS

VERTICAL

PUMPS

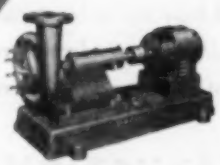
...WITH THE ACQUISITION OF

DAYTON-DOWD COMPANY

BY THE PEERLESS PUMP DIVISION

FOOD MACHINERY

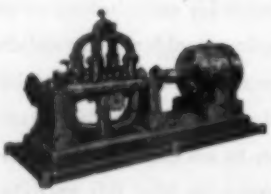
★ Complementing the eminent line of Peerless *Vertical* Turbine, Hi-Lift, Hydro-Foil, Jet and Water King Pumps, Peerless now manufacturers *Horizontal* Centrifugal Pumps, formerly Dayton-Dowd.



Peerless has acquired the Dayton-Dowd Company of Quincy, Illinois, which henceforth will be operated as the Quincy Works of Peerless Pump Division.

So now, regardless of the type of pump you need—Peerless produces it, giving you choice of *vertical* or *horizontal* design, plus augmented hydraulic engineering service.

Advise us as to the type of pump desired—whether vertical or horizontal—capacity and lift. We will be pleased to submit full specifications and engineering details.



Peerless Pumps VERTICAL & HORIZONTAL

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ton Mills Abrasive Co., Inc., 8 E. 41st Street, New York 17, N. Y.—Illustrated folder describing the applications and installations of emery flooring.

Floors. Nukem Products Corp., Buffalo 20, N. Y.—12-page illustrated booklet describing corrosion and wear-proof flooring for process industries and plants.

Friction Materials. Equipment Sales Division, Raybestos-Manhattan, Inc., Passaic, N. J.—Brief catalog describing friction materials for industrial machinery.

Gaskets. U. S. Gasket Co., 1690 Pierce Ave., Camden, N. J.—4-page leaflet giving construction details and specification data for Ajax spiral-wound gaskets.

Gears. Foote Bros. Gear Machine Corp., 5225 Southwestern Blvd., Chicago 9, Ill.—63-page booklet illustrating and describing the application and selection of this company's aircraft quality gears. Considerable space is devoted to engineering data and tables showing design and capacities of various types of gears.

Heat Exchangers. American District Steam Co., North Tonawanda, N. Y.—Bulletin 35-76B. 12-page loose-leaf bulletin describing the various types of heat exchanger units made by this company. Engineering data given includes dimensions, capacities and weights, together with list prices of the various types of units.

Industrial Equipment. York Safe & Lock Co., York, Pa.—Bulletin RS-3M-45. 40-page illustrated booklet featuring the facilities and products of this company.

Instruments. The Bristol Co., Waterbury 91, Conn.—16-page bulletin showing the several different types of electric pyromaster controllers together with operation and application information.

Instruments. The Bristol Co., Waterbury 91, Conn.—6-page reprint discussing flow tank consistency control in the pulp and paper industry which reviews and summarizes work done in this particular field.

Instruments. The Hays Corp., Michigan City, Ind.—Bulletin 45-713. 28-page illustrated booklet featuring typical applications of instrument controllers to various industrial control problems. Application diagrams and recommended instrumentations are given.

Instruments. Taber Instrument Corp., North Tonawanda, N. Y.—6-page leaflet describing and illustrating a power-driven stiffness gage for determining standard measurements of the stiffness and resilient qualities of flexible materials up to ¼ in. in thickness such as laminated plastic, cardboard, light metallic sheets and wire.

Leather Packing. Chicago Belting Co., 113-125 N. Green St., Chicago, Ill.—63-page booklet illustrating and describing the design and application of hydraulic and pneumatic leather packing. This booklet is well-illustrated to show installation applications, construction and design details. Useful engineering information together with installation and operation hints add to the value of this booklet.

Leather Packing. Darling Valve & Mfg. Co., Williamsport, Pa.—Bulletin 4502. 8-page illustrated booklet describing Darcova Pumcups for use in air and hydraulic cylinders. Types of applications together with engineering data are included.

Safety Lighting Equipment. Stewart Brown Mfg. Co., Inc., 258 Broadway, New York 7, N. Y.—24-page catalog featuring safety electrical equipment including industrial flashlights, inspection lights, explosion-proof lights, etc.

Lubricants. Fisk Bros. Refining Co., 129 Lockwood St., Newark 5, N. J.—28-page lubrication service handbook describing the application of lubricants made by this company.

Magnetic Equipment. Stearns Magnetic Mfg. Co., Milwaukee 4, Wis.—Folder describing the application of magnetic devices for removing tramp iron and metallic junk automatically and economically from flowing materials.

Materials Handling. Clark Equipment Co., Battle Creek, Mich.—24-page booklet illustrating the many applications of Clark Trucktractors.

Oil Separators. Gale Oil Separator Co., Inc., 52 Vanderbilt Ave., New York 17, N. Y.—16-page folder describing Gale systems for recovering oil from waste water and for the prevention of the various types of industrial water pollution.

Packaging. General Box Co., Chicago, Ill.—Illustrated booklet giving information on the

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for EASE OF OPERATION LOW MAINTENANCE COSTS

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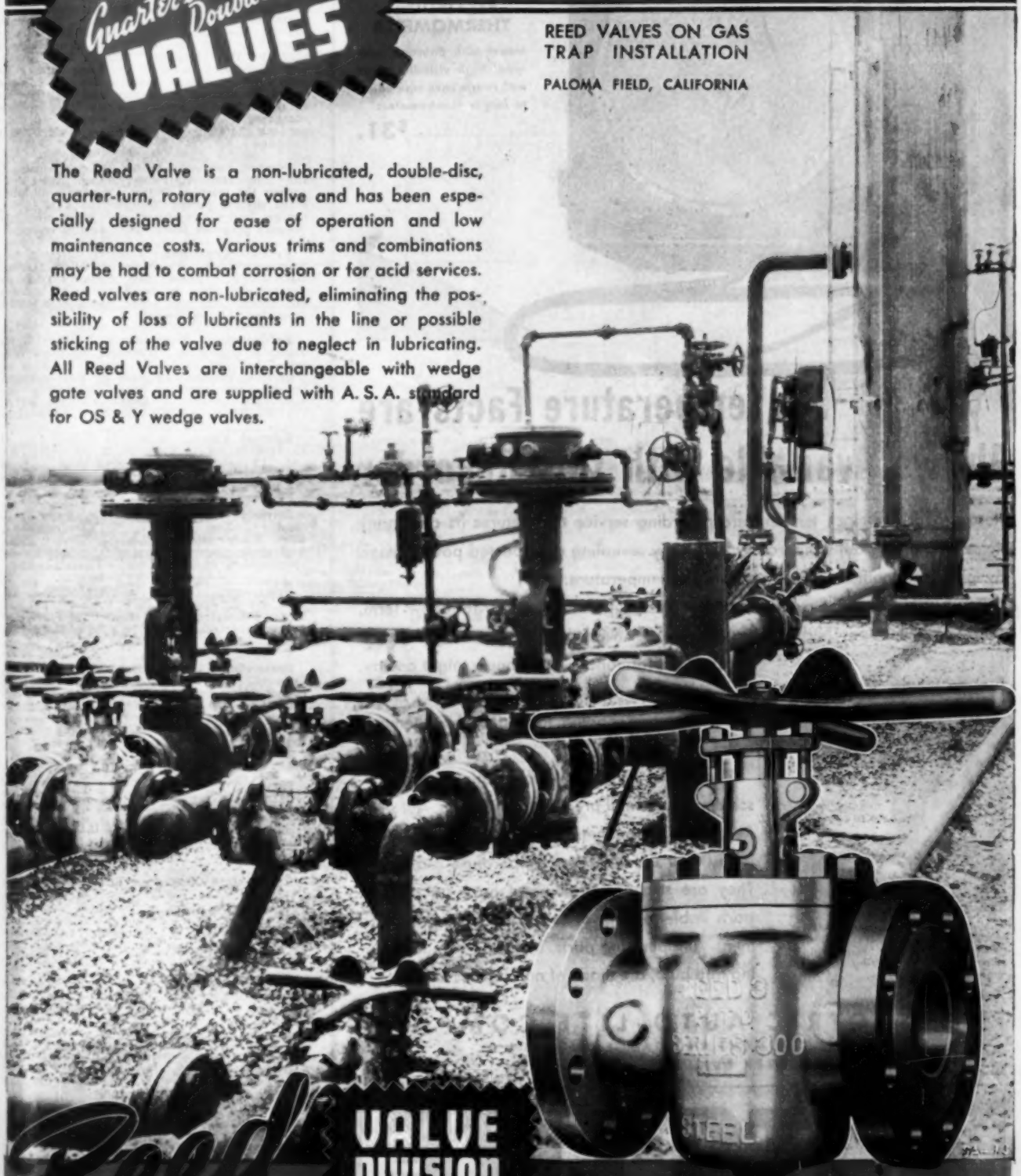

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Model 500. Bourdon tube type. High visibility chart with range coverage equal to larger thermometers.

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By charting continuous temperature cycles in permanent easy-to-follow form, Auto-Lite Recording Thermometers provide you with definite knowledge of temperature performance—at all hours, night or day. They are equipped with bulb and capillary tubing to permit distant reading. Recording shows temperature at bulb point.

Auto-Lite Indicating Thermometer, Model F-1. Used wherever temperature is a factor. With rigid stem or capillary tubing for remote reading. $20.

Because of Auto-Lite specialization and large-scale production of precision instruments, Auto-Lite Recording Thermometers are priced low enough to justify their use wherever temperature is a factor. They are strongly made, and have no delicate parts liable to wear or to require frequent adjustment. All operating parts, including capillary tubing and bulb, are made of non-ferrous metals.

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various types of crates, boxes and packaging materials.

Pipe Welding. Cornell & Underhill, Inc., 149 Broadway, New York 6, N. Y.—4-page illustrated leaflet features pipe welding facilities of this company.

Process Engineering. Sam Tour & Co., Inc., 44 Trinity Place, New York, N. Y.—4-page folder outlining the engineering services and facilities of this company.

Process Equipment. General American Transportation Corp., 420 Lexington Ave., New York 17, N. Y.—Bulletin No. 250. 8-page folder illustrating and describing the drum dryers made by this company. Bulletin No. 53. 8-page illustrated booklet describing this company's rotary dryers. Bulletin No. 52. 6-page leaflet illustrating the design and construction of the Louisville Rotary Dryers built by this company. Bulletin No. 100. 4-page leaflet describing the Conkey sludge filters made by this company.

Pumps. Fairbanks Morse & Co., Chicago 5, Ill.—Publication AQB 400-1, 6-page leaflet illustrating the features of this company's oil-lubricated turbine pumps. Publication AQB 500.1, 6-page leaflet describing and illustrating the Niagara propeller pumps built by this company.

Pyranol Capacitors. General Electric Co., Schenectady, N. Y.—Bulletins GEA-77L and GEA-2027B. These two booklets describe pyranol capacitors in detail giving engineering application data and other useful information regarding this equipment.

Refrigeration Compressors. Worthington Pump & Mfg. Corp., Harrison, N. J.—4 illustrated bulletins describing several types of refrigeration compressors made by this company. Specifications together with outstanding features are given. Bulletins C-1100—B11A; C-1100—B18A; C-1100—B19A; C-1100—B26.

Solenoid Valves. Automatic Switch Co., 41 E. 11th St., New York, N. Y.—Circular No. 200. 12-page booklet featuring Asco solenoid valves for the automatic and remote control in the flow of liquids and gases.

Solvents. Commercial Solvents Corp., 17 E. 42nd St., New York 17, N. Y.—Bulletin I-4504. 8-page illustrated booklet giving industrial applications, technical data, properties and specifications of 2-Methyl-2, 4-Pentanediol.

Spectrometer. North American Phillips Co., Inc., 100 E. 42nd St., New York 17, N. Y.—8-page illustrated booklet describing the Geiger counter spectrometer for use in industrial research.

Spray Guns. B. F. Goodrich Co., Akron, Ohio—22-page booklet describing the Loan rubber blow and spray guns which give constant finger-tip control of air or water under pressure without the use of levers, springs, pushbuttons or screws. Details of construction, together with application data are given.

Storage Batteries. Philco Corp., Storage Battery Division, Trenton, N. J.—A manual consisting of a compilation of information on the various industrial applications of storage batteries. Included is a wide range of battery facts. Specifications, capacities, and illustrations of all types of batteries made by this company are given.

Temperature Control. Precision Scientific Co., 1750 N. Springfield Ave., Chicago 47, Ill.—Catalog 325. 50-page illustrated catalog describing temperature control cabinets and ovens manufactured by this company. Construction details, specifications, together with application data are included.

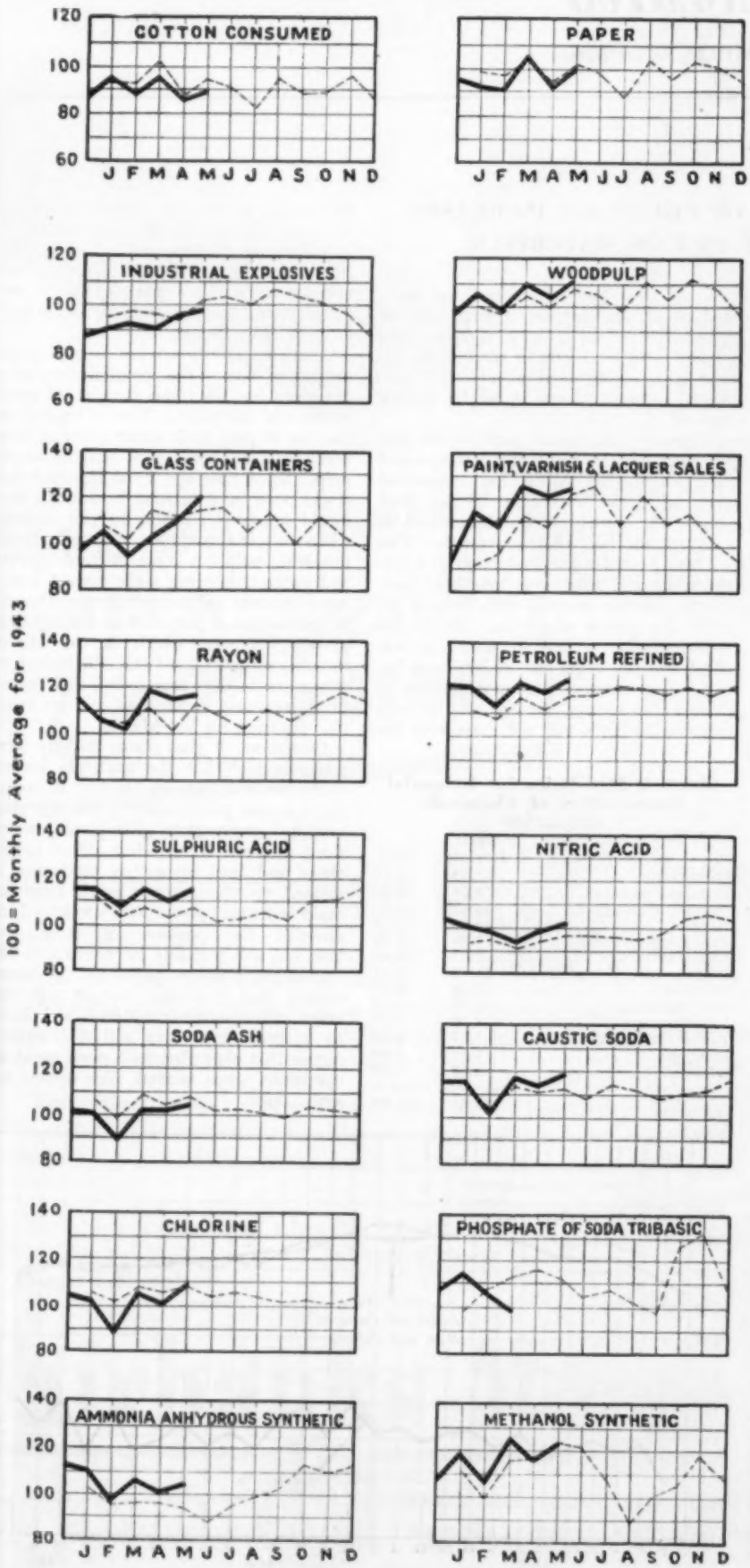
Valves. Merco-Nordstrom Valve Co., 400 North Lexington Ave., Pittsburgh 8, Pa.—Catalog No. 9. 134-page catalog listing valves, specifications, engineering tables, lubrication data, etc. and includes the latest information regarding the entire line of valves made by this company. Bulletin B-126. This booklet is an instruction manual designed to guide users of valves in the proper methods of lubricating plug valves.

Vanadium Alloys. Vanadium Corp. of America, 420 Lexington Ave., New York 17, N. Y.—This company is resuming publication of its house organ, The Vancoram Review, to be issued quarterly. This publication is designed to be a practical aid to the advancement and progress in the field of alloys, metals and allied chemical compounds.

X-Ray Equipment. Picker X-Ray Corp., 300 Fourth Ave., New York, N. Y.—12-page illustrated booklet describing industrial X-ray units for testing materials having a relatively low density, such as plastics, plywood, etc.

100 = Monthly Average for 1943

PRODUCTION AND CONSUMPTION TRENDS



THE MOST important development of the month is connected with the distribution of chemicals as well as of other raw materials and finished products. It is found in an announcement by the chairman of the War Production Board which states that the priorities system will be revised and will be carried out in such a way that priorities will be eliminated except in cases where military requirements must be safeguarded. There will be a six months' transition period from July 1 to the end of the year to give business an opportunity to adjust its operations to the changed system, which will go into effect on Jan. 1, 1946.

Throughout the war period, a large part of raw materials and finished products has been distributed under directives. With the probability that these directives no longer are necessary, or soon will become so, it is felt that a blanket discontinuance of controls might create confusion. Hence the new order is designed to make the change gradually with as little disturbance to the respective markets as possible.

While cancellations and cutbacks in government requirements have had the general effect of easing the supply situation, this does not mean that all raw materials are in ample supply. In many cases shortages still exist and there has been no departure from the trend which forces the use of substitute materials. In the first place, the chemicals necessary for the manufacture of ammunition have been in active demand for that purpose. Production in every major munitions category except ammunition declined in May, yet a rise of 2 percent was reported for ammunition in that month. Shortage of corn brought a suspension of operations at one large corn products plant with others working on a restricted basis. Paint makers are faced with an active consuming demand and a short supply of many vital materials. These shortages include such important supplies as pigments, drying oils, chemical colors, and shellac. In the drying oil field, castor oil has been called on to take up much of the slack but stocks of the oil became so short that it had to be placed under control.

In the heavy chemical list, sulphuric acid is making a good showing with added capacities enabling current outputs to outstrip those of last year. Demand for chlorine has been less active and this has been reflected in production schedules and it is noted that more caustic soda is coming from lime-soda plants than had been the case in earlier months.

Foreign trade is expected to become an important factor on domestic production with unofficial reports that studies are under way looking toward the revision of existing trade agreements with outside countries and the forming of new agreements with countries not now included. While the reciprocal agreements undoubtedly will include Great Britain and the Dominions, it is probable that arrangement with South American countries will admit of earlier completion.

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

INDUSTRIAL CONSUMPTION OF CHEMICALS INCREASES WITH SOME EASEMENT IN RAW MATERIALS

THE *Chem. & Met.* index for industrial consumption of chemicals reached a new high of 192.90 in May which compares with a revised figure of 184.58 for April. In 1944 the index numbers were 189.42 for May and 180.76 for April. The position of raw materials has shown some improvement which is favorable for further expansion of industrial activities. Allocations of chemicals for June were more liberal in respect to the amounts assigned for civilian purposes and the growing list of chemicals which are removed from distribution controls, gives further proof of the easier supply position.

Based on the indexes of the Federal Reserve Board, total production of industrial chemicals in the first half of this year did not differ much from that of the comparable 1944 period. Cutbacks in some of the military programs had some effect on the rate of chemical production but for the most part the cutbacks had but little influence since they involved production where chemicals were not extensively used. As a result chemical outputs in the first six months of this year fell off less than 2 percent from the like figure for 1944.

Unofficial reports credit a definite trend toward a lowering in chemical production since May with a reduction in export shipments having much to do with a drop in over-all demand. However, consumption of chemicals is not expected to show any sharp reversal. So far the military program has called for a continuance of ammunition outputs and requirements for high-octane gasoline and synthetic rubber give promise that these producing industries will work at capacity while the war continues and in the case of synthetic rubber, it is possible that capacity production will be maintained for some time into the postwar period. The Rubber Reserve Co. has revealed that domestic production of synthetic rubber reached a total of 737,000 long tons last year with 378,000 tons turned out in the first five months of 1945 to which may be added an unofficial figure of 78,000 tons for June, giving a grand total of 456,000 tons for the first half of the year. The schedule calls for an output of 1,000,000 tons this year with a peak production of 1,200,000 tons set for 1946.

The *Chem. & Met.* index for industrial consumption of chemicals has run counter to the Federal Reserve Board's index for chemical production and shows a moderate gain for the first half of this year. The term industrial consumption, however, must be taken with some reservations since some of these privately owned and operated plants are shipping a large part of their outputs to the military. For instance, sales of paint and varnish reached an all-time high in May but a very large percentage of these sales were not for civilian account.

Apparently the added facilities for producing sulphuric acid have accomplished their purpose for WPB has announced that, with the exception of far west points, the supply of sulphuric acid is adequate to meet all requirements. This has been favorable for production of superphosphate and acidulators have been busy in the last few months with outputs far above the prewar standards. While the food program is tied in with the war effort and the larger use of fertilizers has come from pressure put upon farmers to expand crop acreage, the necessity for large crops of all kinds will not cease with the termination of the war. Furthermore, experience has proved the desirability of large fertilizer consumption and it is probable that production of superphosphate and mixed fertilizers will not decline to any extent until there has been an appreciable drop in farm income.

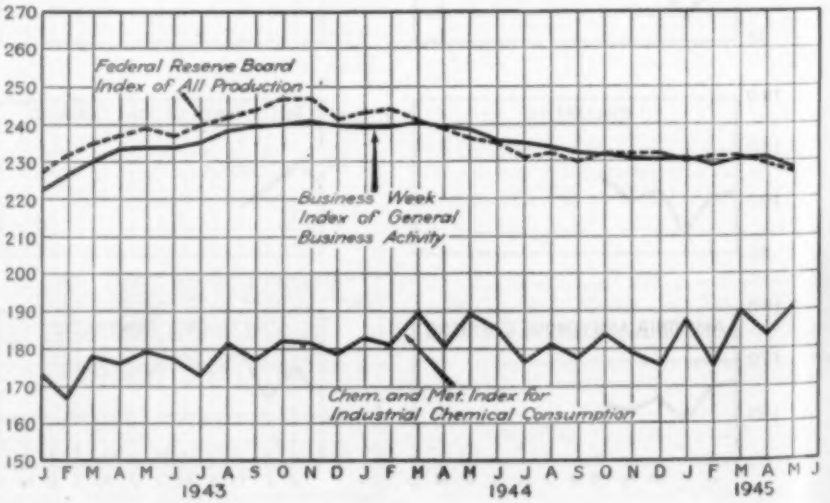
Another factor which has favored larger outputs in some of the chemical-consuming industries has been the promise of more ample raw materials. This is typified in the case of pulp mills where activities have been curtailed because of lack of woodpulp. Some time ago it was reported that stocks were accumulating in Sweden and would be made available to this country when shipping could be arranged. Some dissolving pulp has come in from Sweden and progress is being made toward bringing in sulphite and sulphate grades. Domestic production of pulp in May was reported at 852,365 tons which is the largest monthly output since 1942. Production of paper, excluding paperboard and newsprint, increased in May but did not equal that reported for last March.

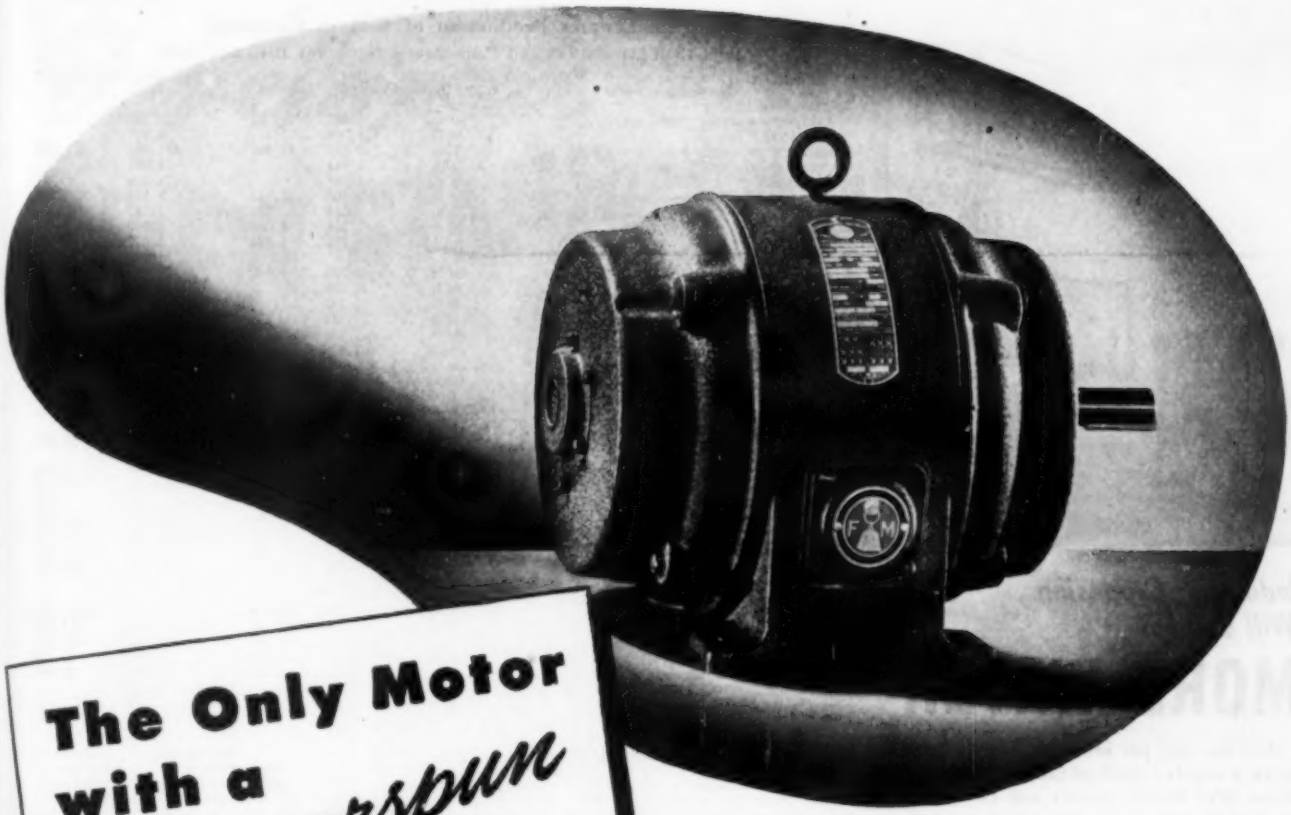
Operations at glass plants in May were relatively high but the container branch made the best showing, in fact it turned out a record performance. The flat glass branch, notably plate glass plants, moves along with one of its widest outlets largely closed and until automotive production is stepped up there is not much hope for sharp rises in plate glass stocks. Incidentally, the position of these two branches will probably be reversed in the immediate postwar period as it seems certain that container output will fall when other container materials are placed on a competitive basis and it is equally certain that plate glass mills must speed up operations when normal sales outlets are again open.

***Chem. & Met.* Index for Industrial Consumption of Chemicals**

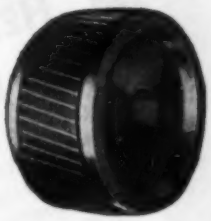
1935 = 100

	April Revised	May
Fertilizers	40.49	41.70
Pulp and paper	18.51	20.20
Petroleum refining	18.52	19.70
Glass	19.00	20.29
Paint and varnish	18.95	19.42
Iron and steel	12.92	13.40
Rayon	18.37	18.74
Textiles	10.58	10.93
Coal products	9.57	10.33
Leather	4.50	4.60
Industrial explosives	5.27	5.40
Rubber	3.00	3.00
Plastics	4.90	5.10
	184.58	192.90





The Only Motor with a *Copperspun* ROTOR



Only in Fairbanks-Morse Motors will you find rotors centrifugally cast in *one piece*—and of *copper!*

The characteristics of copper make it the ideal rotor material. Copper has high electrical and thermal conductivity (twice as good as aluminum), greater strength, and low thermal expansion.

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Ball Bearings—Sealed in and protected.

Recessed Conduit Box—An innovation for neat installations in close quarters. Conventional box also provided.

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Balanced Characteristics—A 40°C. motor with high efficiency and power factor, and excellent starting and accelerating torques.

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MORE WATER

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If you are looking toward economy in your industrial water system, Layne has many basic facts to present—facts that may save you many hundred dollars annually. Write, wire or phone for further details. LAYNE & BOWLER, INC., General Offices, Memphis 8, Tennessee.

LAYNE PUMPS *—fulfill every need for producing large quantities of water at low cost from wells, streams, mines or reservoirs. Send for literature.*

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LAYNE

WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

United States Production of Certain Chemicals

April 1945, April 1944 and Four-Month Totals for 1945 and 1944

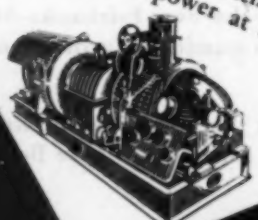
Chemical and Basis [a]	Units	April 1945	April 1944	Total, First 4 Months 1945	Total, First 4 Months 1944
Aluminum chloride:					
Anhydrous & crystal (100% $AlCl_3$)	M lb.	4,982	.....	20,285	.....
Solution (32° Be)	M lb.	1,096	.....	4,207	.....
Ammonia, synthetic anhydrous (100% NH_3)[b]	Tons	45,581	43,191	189,389	175,883
Ammonium chloride (100% NH_4Cl)	M lb.	5,734	.....	21,081	.....
Barium sulphate (100% $BaSO_4$)	M lb.	5,249	.....	18,966	.....
Bleaching powder (35-37% avail. Cl_2)	M lb.	2,662	5,343	9,471	21,821
Calcium acetate (80% Ca $(C_2H_3O_2)_2$)	M lb.	519	775	2,347	4,068
Calcium arsenate (100% $Ca_3(AsO_4)_2$)	M lb.	1,556	4,099	7,590	13,989
Calcium hypochlorite (70% avail. Cl_2)	M lb.	1,254	1,241	5,071	4,745
Calcium phosphate:					
Monobasic (100% $CaH_4(PO_4)_2$)	M lb.	4,722	3,882	20,782	20,848
Dibasic (100% $CaHPO_4$)	M lb.	4,020	.....	14,929	.....
Carbon, activated	M lb.	5,105	.....	19,906	.....
Carbon black (channel): Rubber grade	M lb.	38,511	.....	145,115	.....
Other grades	M lb.	2,658	.....	10,161	.....
Chlorine	Tons	103,478	106,764	406,963	422,996
Chrome green (C.P.)	M lb.	407	524	2,124	2,062
Chrome yellow & orange (C.P.)	M lb.	3,552	.....	13,496	.....
Hydrochloric acid (100% HCl)	Tons	37,597	29,671	144,062	116,785
Hydrogen peroxide (100 volumes)	M lb.	2,779	.....	10,690	.....
Lamp black	M lb.	1,156	.....	4,553	.....
Lead oxide: Red (C.P.)	M lb.	7,845	8,855	43,063	35,813
Yellow (C.P.)	M lb.	27,404	.....	112,875	.....
Methanol: Natural (80% CH_3OH)	M gal.	293	341	1,203	1,426
Synthetic (100% CH_3OH)	M gal.	6,378	6,320	25,451	24,016
Molybdate chrome orange (C.P.)	M lb.	135	114	501	517
Nitric acid (100% HNO_3)	Tons	40,053	38,161	158,959	130,444
Phosphoric acid (50% H_3PO_4)	Tons	39,502	57,807	215,284	250,181
Potassium bichromate & chromate (100%)	M lb.	516	638	2,357	2,791
Potassium hydroxide (100% KOH)	Tons	4,759	3,494	17,431	14,430
Soda ash (commercial sodium carbonate):					
Ammonia-soda process (98-100% Na_2CO_3)					
Total wet & dry[c]	Tons	378,385	385,185	1,456,426	1,542,292
Finished light[c]	Tons	210,130	206,990	786,115	848,266
Finished dense	Tons	114,133	124,727	450,515	485,860
Sodium bicarbonate (100% $NaHCO_3$)	Tons	15,407	12,791	55,143	55,152
Sodium bichromate & chromate	Tons	6,852	6,920	27,309	28,548
Sodium bisulphite (100% $NaHSO_3$)	M lb.	3,486	.....	12,652	.....
Sodium hydrosulphide (100% NaSH)	M lb.	1,959	.....	7,151	.....

(Table continued on p. 250)

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census and WPB Chemicals Bureau. Production figures represent primary production and do not include purchased or transferred material. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given, data are either confidential or not yet available. [1] Includes a small amount of aqua ammonia. [2] Total wet and dry production including quantities diverted for manufacture of sodium bicarbonate and caustic soda and quantities processed to finished light and finished dense. [3] Not including quantities converted to finished dense. [4] Data collected in cooperation with the Bureau of Mines. [5] Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6] Include oleum grades. Excludes spent acid.

HENDY HAS NEWS FOR YOU . . .

The Hendy Turbo-Generator is designed to meet your most exacting power requirements, from 250 kw up. The coupon below will bring you complete information, explaining how the Hendy Turbo-Generator, geared or direct drive, is specifically designed and built to operate as a matched unit, providing reliable power at *low* cost.



Clip this coupon, mail it today!

Please send me your 2-color illustrated booklet describing the *new* Hendy Turbo-Generators.

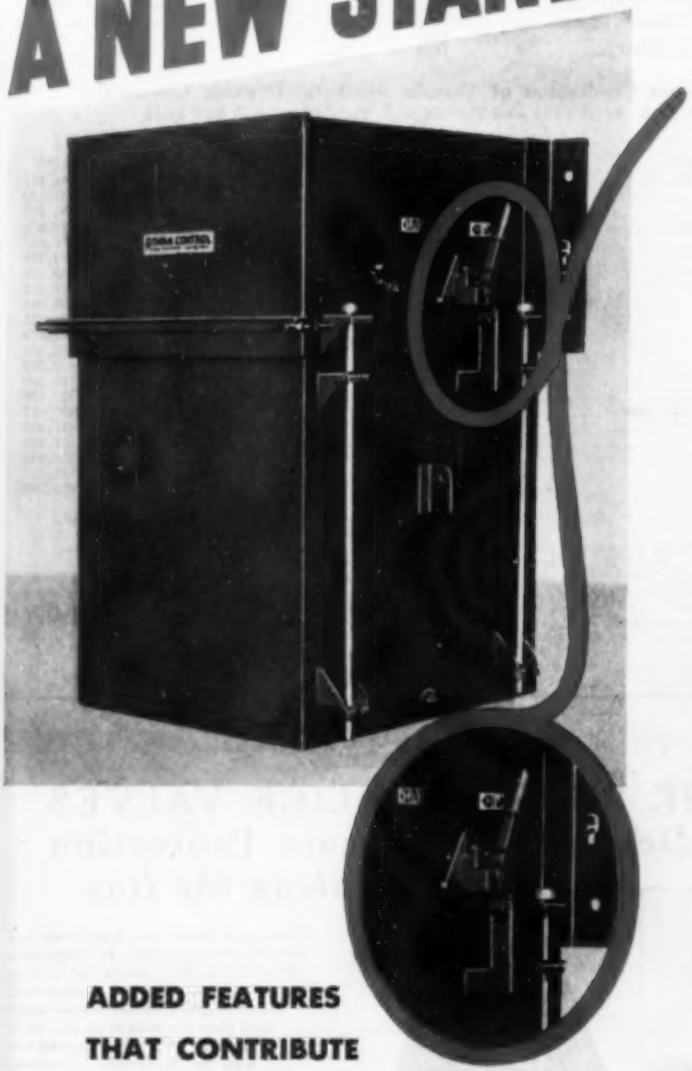
*Name*_____

*Company*_____ *Position*_____

*City*_____ *Zone*____ *State*_____

JOSHUA **HENDY** IRON WORKS
ESTABLISHED 1856
SUNNYVALE, CALIFORNIA

Developed A NEW STANDARD IN SAFETY!



THE ROWAN 900-KBF COMBINATION, OIL IMMERSED, REDUCED VOLTAGE, IMPEDANCE TYPE AC MOTOR STARTER

This up-to-the-minute starter is a *combination* of our reduced voltage impedance starter and oil immersed safety disconnect switch with Rowan Air-Seal Fuses and Seal-Off Compartment for line, motor and control leads. Combining these Rowan advancements into one single unit conserves installation space and costs. *Maximum Safety is provided by mechanically interlocking the operating mechanism of the Safety Disconnect Switch with the Oil Tank.*

Reduced starting voltage is obtained by the use of continuous-wound coils with mechanical adjustment for varying the impressed voltage thereby eliminating tap failures.

The time of acceleration is determined by the motor and its connected load. There is no disconnecting of the motor from the line at any period during acceleration. This assures a minimum of line disturbance.

For safety, smooth acceleration, continuity of service and low overall cost—This ROWAN Type 900-KBF Combination Reduced Voltage Starter "Tops them all." Complete detailed information sent on request.

ADDED FEATURES THAT CONTRIBUTE TO SAFETY, LOW INSTALLATION COSTS AND CONTINUITY OF SERVICE

1. **Safety disconnect switch is completely interlocked with the oil tank in raised or lowered position—positive line disconnection.**
2. **Magnetic overload relays, combination of inverse time element, instantaneous operation—automatic Reset.**
3. **Rowan Air-Seal Fuses—A proven short circuit protection.**
4. **Fully automatic—Push-Button Operated.**
5. **Oil Immersed for maximum safety and protection.**
6. **Enclosure is of dust-tight construction.**
7. **Seal-off Terminal Compartment arranged for top and bottom conduit connections.**

More than a generation devoted to the design and manufacture of Oil Immersed AC Motor Controls.

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

A Newcomer to the METALLURGICAL FIELD!

• • • •

THE

AVALANCHE SEPARATOR

A high capacity unit developed for removing stones from food products is now being used in metallurgy. For example, one unit handles 32,000 pounds of peanuts per hour removing all rocks, glass, etc.

• • • •

Separates a small amount of heavies from a large amount of lights. For example, a small amount of quartz from mica, or rocks from asbestos.

• • • •

Material flows downhill across rapidly oscillating deck, by gravity, rendered "fluid" by diffused air stream from blower below. Heavies sink immediately, work uphill and out the throat at higher end.

• • • •

Our engineers will be glad to help solve your separating or concentrating problems and submit recommendations. Send sample for laboratory tests.

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DALLAS, TEXAS
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SEPARATIONS ENGINEERING CORPORATION
110 EAST 42nd STREET, NEW YORK, N. Y.
OLIVER BUILDING, PITTSBURGH, PENNSYLVANIA
ENGINEERING BUILDING, CHICAGO, ILLINOIS
FLOUR EXCHANGE BUILDING
MINNEAPOLIS, MINNESOTA
41-43 DRUMM STREET
SAN FRANCISCO, CALIFORNIA

S&S PROCESS — THE S&S PROCESS FOR BETTER PRODUCTS—FASTER

U. S. Chemical Production (Cont. from p. 248)

Chemical and Basis	Units	April 1945	April 1944	Total, First 4 Months 1945	Total, First 4 Months 1944
Sodium hydrosulphite (100% $Na_2S_2O_4$)	M lb.	3,174	.....	12,870	.....
Sodium hydroxide (100% NaOH): Electrolytic process[4]					
Liquid	Tons	97,440	99,052	384,728	395,299
Solid	Tons	18,577	.....	75,462	.....
Lime-soda process					
Liquid	Tons	64,021	58,037	251,531	226,367
Solid	Tons	19,862	.....	79,095	.....
Sodium silicate (anhydrous)	Tons	36,706	.....	145,873	.....
Sulphuric acid (100% H_2SO_4):					
Chamber process	Tons	262,387	263,132	1,112,098	1,109,819
Net contact process[5]	Tons	475,590	428,712	1,898,091	1,730,481
White lead: Basic lead-carbonate	Tons	3,432	.....	13,614	.....
Basic lead sulphate	Tons	781	.....	3,758	.....
Zinc yellow (zinc chromate) (C.P.)	Tons	1,514	.....	6,990	.....

United States Production of Certain Synthetic Organic Chemicals

April 1945, April 1944 and Four-Month Totals for 1945 and 1944

Item	April 1945	April 1944	Total, First 4 Months 1945	Total, First 4 Months 1944
Acetanilide, technical and U. S. P.	637,308	643,396	*1,738,775	2,381,411
Acetic acid, synthetic[1]	22,564,074	24,471,598	94,059,095	101,261,120
Acetic acid, natural[2]	3,081,745	3,448,145	11,807,907	13,588,376
Acetylsalicylic acid, aspirin	498,074	676,095	3,574,905	3,023,938
n-Butyl acetate	6,479,003	6,235,207	24,507,186	26,079,361
Creosote oil, tar distillers[3]	11,152,804	10,869,901	43,712,386	45,043,370
Creosote oil, byproduct[4, 5]	3,111,764	3,562,500	12,672,287	12,748,254
Cresols, meta-para[3]	615,613	640,698	2,563,531	2,398,218
Cresylic acid, crude	2,379,958	2,141,226	9,060,968	8,359,040
Cresylic acid, refined[3]	2,730,465	3,342,989	10,714,794	13,551,731
Diethyl ether	8,206,693	5,484,234	31,109,435	20,216,479
Ethyl acetate	9,793,282	7,675,579	37,210,246	36,782,355
Lactic acid, edible	380,755	381,579	1,401,255	1,402,599
Lactic acid, technical	375,396	322,610	1,694,739	1,141,320
Methyl chloride, all grades	2,366,809	2,136,340	9,903,795	6,736,159
Naphthalene, coke-oven operators[6, 7]	8,000,052	8,288,927	30,179,535	35,460,917
Naphthalene, tar distillers[7, 8]	17,389,806	17,013,390	66,741,255	65,447,109
Naphthalene, refined[9]	6,187,904	7,578,823	22,639,966	30,795,837
Oxalic acid, technical	1,703,315	1,367,574	6,726,109	5,823,402
Phthalic anhydride	11,482,105	10,607,574	42,882,902	39,833,952
Sulfa drugs, total[10]	377,260	520,867	1,742,533	2,469,256

Statistics collected and compiled by the U. S. Tariff Commission except where noted. In pounds except that creosote oil is expressed in gallons. [1] Excludes recovered acetic acid. [2] Acetic acid produced by direct process from wood and from calcium acetate. Compiled by Bureau of Census. [3] Product of distillers of purchased tar only. [4] Product of byproduct coke-oven operators only. [5] Statistics collected and compiled by Coal Economics Division, U. S. Bureau of Mines. [6] Statistics reported by byproduct coke-oven operators combined with those reported by tar distillers to prevent disclosure of operations of individual companies. [7] Statistics combine three grades: sodifying at less than 74; 74 to less than 76; and 76 to less than 79 deg. C. [8] Production for sale only in case of less than 74 grade. Production both for consumption within producing plant and for sale in case of other two grades. [9] 79 deg. C. and over. [10] Includes data for acetylsulfathiazole, both as drug and as intermediate, resulting in appreciable unavoidable duplication. * Three-month total, January figure confidential.

Lonergan

THESE STURDY RELIEF VALVES Give *Dependable* Pressure Protection ... *all along the line*

Lonergan
GENERAL PURPOSE
BRONZE RELIEF VALVES
Models "R" and "RU"

Model "R" (VAPOR TYPE) for STEAM, AIR or GAS
Model "RU" (HYDRAULIC TYPE) for LIQUIDS

They look alike ... but their internal arrangement is different. The Model "R"—designed for line and pressure vessel protection, has a popping chamber and control ring for steam or air service. The "RU" is adapted for use on hydraulic systems, feed water lines, pumps and tanks.

These two compact, sturdily constructed companion valves, provide generous relief capacity ... they are suitable for many relief valve applications. The Model "RU" for example, is an effective "snifter" or condensate relief valve for steam engine cylinders.

Do not specify the Model "R" where A.S.M.E. Code requirements call for the approved lever type safety valve. Such applications indicate the use of Lonergan Model "ODP", with cap and lever.

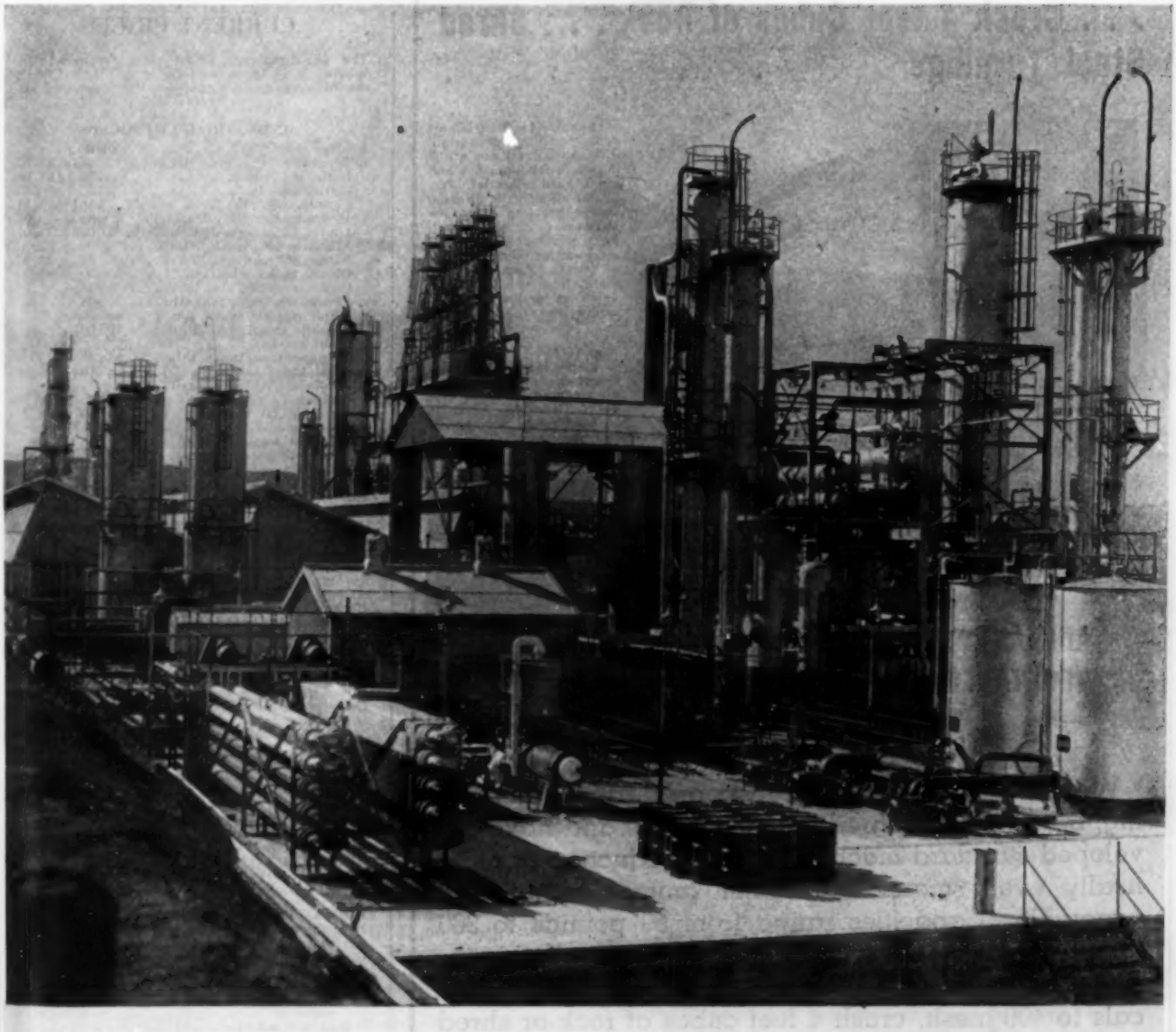
Lonergan safety and relief valves cover a wide range of services. No matter what your needs may be, there is a competently engineered, quality-built Lonergan valve to serve your purpose. Write for Bulletin 507. Let us submit recommendations for the particular inquiry or application you have in mind.

J. E. LONERGAN COMPANY, 200 Race Street, Philadelphia 6, Pa.

Lonergan — *Safety Valves • Relief Valves Pressure Gauges • Specialties*

SINCE 1872—*Makers of Pressure-Safety Appliances for the Power, Mechanical, and Process Industries*

SPECIALIZATION...



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From engineering design to final construction, Bechtel-McCone's years of experience in the Petroleum and Chemical Industries result in an intelligent approach to their problems.

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ENGINEERS & CONSTRUCTORS

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WILLIAMS

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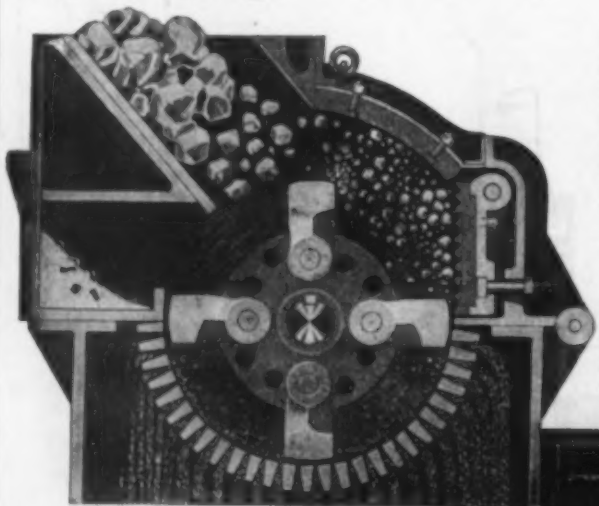
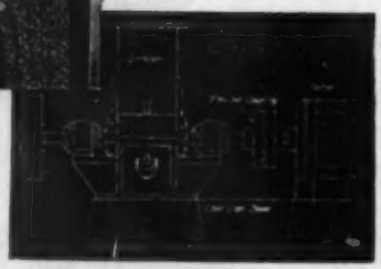
FOR INDUSTRIAL USE . . . Grind Chemicals . . . Crush 4 feet Cubes of Rock . . . Shred Steel Turnings . . . . . .



Sectional view of Williams over - running hammermill with heavy liners and grinding plate for limestone and other hard material. Particular attention is directed to the grinding plate adjustment which assures uniform close contact of hammers and grinding plate at all times. Also note the metal trap which provides an outlet for the escape of tramp iron.

Williams Hammer Grinder direct connected to motor, all mounted on heavy cast base. This type of drive is economical to operate and easy to install.



Reduces

ANIMAL . . . MINERAL VEGETABLE MATTER

Capacity from 50 pounds to 300 tons per hour

• Williams is the world's largest organization of crushing, grinding and shredding specialists and have developed standard machines for the reduction of practically every material whether animal, mineral or vegetable. Capacities range from 50 pounds to 300 tons per hour permitting selection of exactly the proper size for your work. Whether you wish to grind chemicals to 400 mesh, crush 4 feet cubes of rock or shred steel turnings, you can profit by Williams' experience.

THE WILLIAMS PATENT CRUSHER & PULVERIZER CO.

2706 North Ninth St. **St. Louis, Mo.**

Sales Agencies Include

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Williams

OLDEST AND LARGEST BUILDERS OF HAMMER MILLS IN THE WORLD

PATENT CRUSHERS GRINDERS SHREDDERS

CHEM. & MET.

Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

This month	108.70
Last month	108.93
July, 1944	109.03
July, 1943	109.33

CURRENT PRICES

The accompanying prices refer to round lots. Where, it is trade custom to sell f.o.b. works quotations are so designated. Prices are corrected to July 13.

INDUSTRIAL CHEMICALS

Acetone, tanks, lb.	$0.06 –
Acid, acetic, 28%, bbl., 100 lb.	3.38 – $3.63
Boric, bbl., ton	109.00 –113.00
Citric, kegs, lb.	.20 – .23
Formic, cbys., lb.	.10½– .11
Hydrofluoric, 30%, drums, lb.	.08 – .085
Lactic, 44%, tech. light, bbl., lb.	.073– .075
Muriatic, 18°, tanks, 100 lb.	1.05 –
Nitric, 36°, carboys, lb.	.05 – .05½
Oleum, tanks, wks., ton	18.50 – 20.00
Oxalic, crystals, bbl., lb.	.11½– .12½
Phosphoric tech., tanks, lb.	.04 –
Sulphuric, 60°, tanks, ton	13.00 –
Tartaric, powd., bbl., lb.	.70½
Alcohol, amyl	–
From pentane, tanks, lb.	.13½–
Alcohol, butyl, tanks, lb.	.10½– .18½
Alcohol, ethyl, denatured, 190 proof	–
No. 1 special, tanks, gal., wks.	.50 –
Alum, ammonia, lump, lb.	.04½–
Aluminum sulphate, com. bags 100 lb.	1.15 – 1.40
Ammonia, anhydrous, cyl., lb.	.14½–
tanks, ton.	59.00 – 69.00
Ammonium carbonate, powd., tech., casks, lb.	.09½– .12
Sulphate, wks., ton	28.20 –
Amyl acetate, tech., from pentane, tanks	.145–
Aqua, ammonia, 26°, drums, lb.	.02½– .03
tanks, ton.	65.00 –
Arsenic, white, powd., bbl., lb.	.04 – .04½
Barium carbonate, bbl., ton	65.00 – 75.00
Chloride, bbl., ton	75.00 – 78.00
Nitrate, casks, lb.	.09½– .11
Blanc fix, dry, bags, ton	60.00 – 70.00
Bleaching powder, f.o.b. wks., drums, 100 lb.	2.50 – 3.00
Borax, gran., bags, ton	45.00 –
Calcium acetate, bags	3.00 –
Arsenate, dr., lb.	.07½– .08
Carbide, drums, ton	50.00 –
Chloride, flake, bags, del., ton.	18.50 – 25.00
Carbon bisulphide, drums, lb.	.05 – .05½
Tetrachloride, drums, gal.	.73 – .80
Chlorine, liquid, tanks, wks., 100 lb.	1.75 – 2.00
Copperas, bgs., f.o.b. wks., ton	17.00 – 18.00
Copper carbonate, bbl., lb.	.19½– .20
Sulphate, bbl., 100 lb.	5.00 – 5.50
Cream of tartar, bbl., lb.	.57 –
Diethylene glycol, dr., lb.	.14½– .15½
Epsom salt, dom., tech., bbl., 100 lb.	1.80 – 2.00
Ethyl acetate, tanks, lb.	.11½–
Formaldehyde, 40%, tanks, lb.	.032–
Furfural, tanks, lb.	.09½–
Glaubers salt, bags, 100 lb.	1.05 – 1.10
Glycerine, c.p., drums, extra, lb.	.17½– .17½
Lead:	
White, basic carbonate, dry, casks, lb.	.08½–
Red, dry, sck., lb.	.09½–
Lead acetate, white crys., bbl., lb.	.12½– .13
Lead acetate, powd., bag, lb.	.11½– .12
Lithopone, bags, lb.	.04½– .04½
Magnesium carb., tech., bags, lb.	.06½– .06½
Methanol, 95%, tanks, gal.	.58 –
Synthetic, tanks, gal.	.24 –
Phosphorus, yellow, cases, lb.	.23 – .25
Potassium bichromate, casks, lb.	.10½– .10½
Chlorate, powd., lb.	.09½– .12
Hydroxide (c'stic potash) dr., lb.	.07 – .07½
Muriate, 60%, bags, unit	.53½–
Nitrate, bbl., lb.	.05½– .06
Permanganate, drums, lb.	.19½– .20
Prussiate, yellow, casks, lb.	.16 – .17
Sal ammoniac, white, casks, lb.	.0515– .06
Salsoda, bbl., 100 lb.	1.00 – 1.05
Salt cake, bulk, ton	15.00 –
Soda ash, light, 58%, bags, contract, 100 lb.	1.05 –
Dense, bags, 100 lb.	1.15 –
Soda, caustic, 76% solid, drums, 100 lb.	2.30 – 3.00
Acetate, del., bbl., lb.	.05 – .06
Bicarbonate, bbl., 100 lb.	1.70 – 2.00
Bichromate, casks, lb.	.07½– .08½
Bisulphate, bulk, ton	16.00 – 17.00
Bisulphite, bbl., lb.	.03 – .04

New ELECTRONIC RESISTANCE THERMOMETER

for Chemical Processing

THE BAILEY PYROTRON

As a resistance thermometer the Pyrotron indicates, records and controls temperatures between -100°F and 1200°F. It simultaneously records as many as four temperatures on its 12-inch chart, or may record and control as many as two temperatures.

An independent continuously connected measuring circuit serves each recording unit. These circuits are kept in continuous balance by sturdy motion-free electronic detectors which do away with the delicate parts and "step by step" action of galvanometer type instruments.

Indicating, recording and controlling instruments are furnished in rectangular casings as illustrated. Indicating and controlling instruments are furnished in 12-inch round type casings.

CHOICE OF THREE CONTROLS

Bailey Pyrotrons are furnished with the following types of Automatic Control:

1. AIR OPERATED—Uses standard Bailey Pilot Valves, air relays, control valves and control drives. Operates by compressed air at 35 lb. pressure.

2. ELECTRONIC—Uses standard electronic control panel operated from a control bridge in the Bailey Pyrotron.

3. ELECTRIC CONTACTS—Uses micro switches on slidewire unit or electronic relay operated from control bridge in the Bailey Pyrotron. P-5

UNUSUAL FEATURES OF THE BAILEY PYROTRON

Suitable for severe service where vibration and shock exist.

Measuring circuit operates from instrument power supply eliminating need for standard cell and dry battery.

Sturdy electronic system maintains continuous balance.

Motor drive furnishes abundant power to operate recorders, controllers and alarm switches.

Two recording controllers may be housed in one casing.

Electronic units may be interchanged without disturbing instrument calibration.

For details, request Bulletin 230-A "Bailey Pyrotron Electronic Resistance Thermometer".
Bailey Meter Company, 1054 Ivanhoe Road, Cleveland 10, Ohio.
In Canada—Bailey Meter Company Limited, Montreal.

BAILEY METER COMPANY

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Controls for Processing

TEMPERATURE
PRESSURE
% OXYGEN
% COMBUSTION
FLOW
LEVEL
DENSITY
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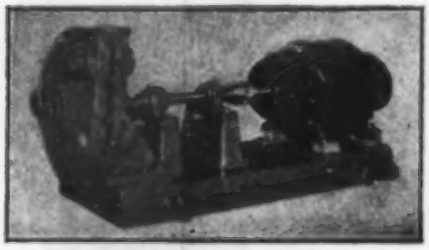
For BOILING and VOLATILE FLUIDS

The handling of hot liquids—particularly when of a corrosive nature, or carrying abrasive contents—is the supreme test of any pump. And in this service, as in so many others, LAWRENCE CENTRIFUGALS are showing a performance marked by high economy, low maintenance, freedom from shut-downs, and long life. Throughout the process industries, they are successfully handling hot acids (including hot sulphuric), hot alkalies, hot sludges and slurries, hot syrups, and hot mixtures carrying abrasive or fibrous materials. Usually, such installations are special problems in which engineering skill and experience are invaluable. Let us work with you. Write for Bulletin 203-3.



Right: — a Lawrence Vertical for handling volatile liquids.

Left: — a Lawrence Horizontal, steam-jacketed for handling viscous materials.

LAWRENCE MACHINE & PUMP CORP.
369 Market Street LAWRENCE, MASS.

LAWRENCE CENTRIFUGALS FOR EVERY PUMPING DUTY

Benefit by the many years of experience in designing and manufacturing of

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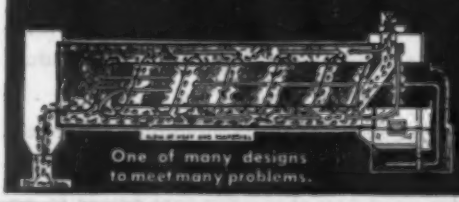
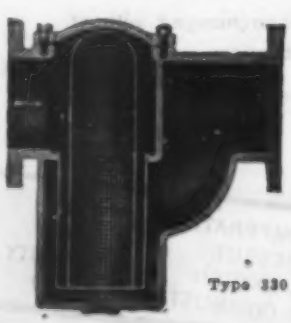


One of many designs to meet many problems.

Dryers
Calciners
Coolers

TO ELIMINATE SHUT-DOWNS

Standardize on K & M Strainers



Type 330

Positive protection for pipe lines and equipment in chemical water, oil, steam applications . . . basket, "Y" and straight-flow strainers from ½" to 18". Minimum pressure drop, easily cleaned. Bodies of standard or X-heavy semi-steel, bronze, galvanized or series 15, 30, 40 or 60 cast steel. Baskets are bronze, monel, stainless steel, wire cloth or special alloys. Write for Catalog, 66-C.

KIELEY & MUELLER, INC.
Manufacturers of Pressure and Level Controls Since 1879
2025-43rd St., North Bergen, N. J.

CHEM. & MET.
Weighted Index of Prices for OILS & FATS

Base = 100 for 1937

This month	145.85
Last month	145.85
July, 1944	145.55
July, 1943	143.60

Chlorate, kegs, lb	$0.06½	$0.06½
Cyanide, cases, dom., lb	.14	.15
Fluoride, bbl., lb	.07	.08
Hyposulphite, bbl., 100 lb	2.40	2.50
Metasilicate, bbl., 100 lb	2.50	2.65
Nitrate, bulk, 100 lb	1.35	
Nitrite, casks, lb	.06½	.07
Phosphate, tribasic, bags, lb	2.70	
Prussiate, yel., bags, lb	.09½	.10
Silicate, 40°, dr., wks., 100 lb	.80	.85
Sulphide, bbl., lb	.02½	
Sulphite, crys, bbl., lb	.02½	.02½
Sulphur, crude at mine, long ton	16.00	
Dioxide, cyl., lb	.07	.08
Dioxide, tanks, lb	.04	
Tin crystals, bbl., lb	.39½	
Zinc chloride, gran, bbl., lb	.05½	.06
Oxide, lead free, bag, lb	.07½	
Oxide, 5% leaded, bags, lb	.07½	
Sulphate, bbl., cwt	3.85	4.00
OILS AND FATS		
Castor oil, No. 3 bbl., lb	$0.13½	$0.14½
Chinawood oil, tanks, lb	.38½	
Coconut oil, ceylon, dr. N. Y., lb.	.0885	
Corn oil crude, tanks (f.o.b. mill), lb	.12½	
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12½	
Linseed oil, raw, car lots, bbl., lb	.155	
Palm, casks, lb	.0865	
Peanut oil, crude, tanks (mill), lb.	.13	
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tank, lb	.11½	
Menhaden light pressed, dr., lb	.13½	
Crude, tanks (f.o.b. factory) lb.	.089	
Grease, yellow, loose, lb	.08½	
Oleo stearine, lb	.09½	
Oleo oil, No. 1, lb	.11½	
Red oil, distilled, bbl., lb	.12½	
Tallow extra, loose, lb	.08½	
COAL-TAR PRODUCTS		
Alpha-naphthol, crude, bbl., lb	$0.52	$0.55
Alpha-naphthylamine, bbl., lb	.32	.34
Aniline oil, drums, extra, lb	.15	.16
Aniline salts, bbl., lb	.22	.24
Benzaldehyde, USP, dr., lb	.85	.95
Benzidine base, bbl., lb	.70	.75
Benzoic acid, USP, kegs, lb	.54	.56
Benzol, 90%, tanks, works, gal	.15	
Benzyl chloride, tech., dr., lb	.23	.25
Beta-napthol, tech., drums, lb	.23	.24
Cresol, USP, dr., lb	.11	
Cresylic acid, dr., wks., gal	.81	.83
Diphenyl, bbl., lb	.15	
Diethylaniline dr., lb	.40	.45
Dinitrotoluol, bbl., lb	.18	.19
Dinitrophenol, bbl., lb	.22	.23
Dip oil, 15%, dr., gal	.23	.25
Diphenylamine, dr. f.o.b. wks., lb.	.60	
H acid, bbl., lb	.45	.50
Hydroquinone, bbl., lbp	.90	
Naphthalene, flak, bbl., lb	.07	.07½
Nitrobensene, dr., lb	.08	.09
Para-cresol, bbl., lb	.41	
Para-nitraniline, bbl., lb	.47	.49
Phenol, USP, drums, lb	.10½	.11
Picric acid, bbl., lb	.35	.40
Pyridine, dr., gal	1.70	1.80
Resorcinol, tech., kegs, lb	.75	.80
Salicylic acid, tech., bbl., lb	.26	.33
Solvent naphtha, w.w., tanks, gal.	.27	
Tolidine, bbl., lb	.96	.98
Toluol, druma, works, gal	.33	
Zylol, com., tanks, gal	.26	
MISCELLANEOUS		
Casein, tech., bbl., lb	$0.18	$0.23
Dry colors		
Carbon gas, black (wks.), lb	.0335	.30
Prussian blue, bbl., lb	.36	.37
Ultramarine blue, bbl., lb	.11	.28
Chrome green, bbl., lb	.23	.33
Carmine, red, tins, lb	4.60	4.75
Para toner, lb	.75	.80
Vermilion, English, bbl., lb	2.75	2.80
Chrome, yellow, C. P., bbl., lb.	.16	.17
Gum copal, Congo, bags, lb	.09	.13
Manila, bags, lb	.09	.13
Damar, Batavia, cases, lb	.10	.12
Kauri, cases, lb	.18	.60
Magnesite, calc, ton	64.00	
Pumice stone, lump, bbl., lb	.05	.07
Rosin, H., 100 lb	7.00	
Shellac, orange, fine, bags, lb	.39	
Bleached, bonedry, bags, lb	.39	
T. N. bags, lb	.31	
Turpentine, gal	.90	

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NEW CONSTRUCTION

PROPOSED WORK

Calif., San Francisco—Golden West Plating Works, 60 Juniper St., plans to rebuild its 3 story plant recently destroyed by fire. Estimated cost $50,000.

Calif., San Jose—International Minerals & Chemical Co., F. H. Catterson, Resident Production Mgr., San Jose, plans to construct a plant to produce mono-sodium glutamate from sugar beet pulp residue on a 260 acre site on Monterey Rd. Estimated cost $1,000,000.

Fla., Jacksonville—Florida Glass Manufacturing Co., Huron St., plans to construct additions to its plant. P. J. D'Larmoyeax, Mgr. Estimated cost $110,000.

Ga., Atlanta—T. E. Schneider, Huff Rd. N. W., plans to construct a soap manufacturing plant. Estimated cost $40,000.

Ill., Chicago—American Colortype Co., 1151 Roscoe St., plans to construct 2 and 3 story additions to its plant. Burnham & Hammond, 160 North LaSalle St., Archt. Estimated cost $400,000.

Ind., Terre Haute—Commercial Solvents Corp., 1331 South First St., has had plans prepared by Miller & Yeager, Archts., 200 Opera House Bldg., for a 3 story, 58x139 ft. laboratory and office building. Estimated cost $350,000.

Kan., Liberal—Northern Natural Gas Co., Liberal, plans to construct a natural gas dehydration and recovery plant. Estimated cost $1,250,000.

Md., Relay—Jos. Seagram & Son, 7th St. Rd., Louisville, Ky., is having plans prepared by Smith, Hinchman & Grylls, Archts., Marquette Bldg., Detroit, Mich., for the construction of a new boiler plant. Estimated cost $500,000.

N. H., North Rochester—Spaulding Fibre Co., Inc., plans to rebuild its plant recently destroyed by fire. Frederick L. Smith, 21 East 40th St., New York, N. Y., Engr. Estimated cost $750,000.

O., Akron—Akron Chemical Co., 1025 Sweltzer Ave., has acquired a site at Mason and Fountain Sts., and plans to construct plant additions. Estimated cost $100,000.

O., Middletown—Sorg Paper Co., 901 Manchester Ave., plans to construct an addition to its plant. J. E. Sirene & Co., Greenville, S. C., Engr. Estimated cost $475,750.

Pa., Bethayres—George E. Fredericks, Philmont and Ann Rds., manufacturer of glassware, plans to construct an addition to his plant. Christian Fries, 3701 North Broad St., Archt. Estimated cost $40,000.

Pa., Philadelphia—Finnoren & Haley, Inc., paint manufacturers, 5620 Summer St., plan to construct an addition to their plant. Estimated cost $40,000.

Tex., Fort Worth—Otis Buightwell, Fort Worth, plans the construction of a chemical plant. Estimated cost $40,000. C. O. Chromaster, Century Bldg., Archt.

	Current Projects		Cumulative 1945	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$750,000	$40,000	$2,960,000	$3,229,000
Middle Atlantic	580,000	.....	5,322,000	15,862,000
South	950,000	.....	19,338,000	21,887,000
Middle West	1,366,000	590,000	10,649,000	24,761,000
West of Mississippi	4,867,000	.....	58,472,000	83,314,000
Far West	1,050,000	3,235,000	4,745,000	7,600,000
Canada	1,325,000	260,000	8,769,000	2,361,000
Total	$10,888,000	$4,125,000	$110,255,000	$159,014,000

Tex., Odessa—United Carbon Co., Inc., Charleston, W. Va., plans to construct a carbon black plant here. Project will be financed by Defense Plant Corp., Washington, D. C. Estimated cost $3,577,000.

W. Va., South Charleston—Union Carbide & Carbon Co., 30 East 42nd St., New York 17, N. Y., plans to construct a research laboratory here. Estimated cost $800,000.

Wis., Marinette—Ansul Chemical Co. plans to construct a 1 story, 50x240 ft. factory and a 1 story, 50x120 ft. warehouse.

Alta., Fort McMurray—Abasand Oil Sands, Ltd., Fort McMurray, plans to construct a separation plant and machine and pipe shop. Estimated cost $300,000.

Ont., Hamilton—Hamilton Potteries, Ltd., plans to reconstruct its plant here. Estimated cost $40,000.

Ont., Hamilton—Lynrock Oils, Ltd., c/o W. C. Byrne, K. C., plans to construct an oil development here. Estimated cost $100,000.

Ont., Hamilton—Niagara Paint & Chemical Co., Ltd., plans to construct a paint, varnish and shellac plant. Estimated cost $40,000.

Ont., Shelburne—Province of Ontario, c/o Ministry of Agriculture, Toronto, plans to construct a glucose plant here. Estimated cost $40,000.

Ont., Toronto—Artcraft Paints, Ltd., 315 Symington Ave., plans to construct two additions to its plant. Adams & Morgan, 3 St. Thomas St., Archts. Estimated cost $90,000.

Ont., Weston—Swift Canadian Co., Ltd., 1960 St. Clair St., Toronto, has purchased a 12 acre site here for the construction of a chemical plant. Estimated cost $300,000.

Que., Montreal—Donovan Plastics Products, Ltd., c/o H. W. Jackson, 1620 Cedar St., plans to construct a factory here. Estimated cost $50,000.

CONTRACTS AWARDED

Calif., Oakland—Owens Illinois Glass Co., 601 56th Ave., Oakland, has awarded the contract for alterations to its plant to H. H. Robertson Co., 689 Mills Bldg., San Francisco, at $56,808.

Calif., Torrance—General Petroleum Corp., 108 West Second St., Los Angeles, has awarded the contract for the construction of a delayed coking plant to M. W. Kellogg Co., 609 South Grand Ave., Los Angeles. Estimated cost $3,049,000.

Mass., Fall River—Firestone Rubber & Latex Corp., Firestone Ave., will alter Buildings Nos. 6, 11 and 23. Work will be done by owner. Estimated cost $40,000.

O., Barberton—Pittsburgh Plate Glass Co., Wooster Rd. and 16th St., has awarded the contract for a 2 story, 90x160 ft. addition to its plant to Carmichael Construction Co., 148 East Miller Ave. Estimated cost including equipment $550,000.

Ore., Portland—Pacific Supply Corp., Chemical Div., 801 S. E. Division Pl., has awarded the contract for the construction of a 1 and 2 story, 200x200 ft. and 60x100 ft. building to process fertilizer at 19th and Upshar Sts., to Reimers & Jolivette, Railway Exchange Bldg. Estimated cost $83,877.

Wash., Hoquiam—Rayonier, Inc., White Bldg., 4th and Union Sts., Seattle, will alter and construct additions to its pulp plant. Work will be done by day labor. Estimated cost $45,000.

Wis., Nekoosa—Nekoosa-Edwards Paper Co., Nekoosa, has awarded the contract for a 4 story, 68x72 ft. and a 1 story, 52x75 ft. factory buildings to Frank J. Henry, 1120 Sixth St., Wisconsin Rapids.

Man., Brandon—Anglo-Canadian Oils, Ltd., 18th and Birchmond Sts., will construct an addition to its plant and install new equipment. Work will be done by owner. Estimated cost $74,000.

Ont., Etobicoke—Pneumatic Insulating Co., Ltd., 24 Adelaide St., has awarded the contract for a 1 story, 74x212 ft. part 2 story, 24x50 ft. rock wool plant in the Lakeshore District, to F. W. McLachlan, 1041 Avenue Rd., Toronto. Estimated cost $100,000.

Ont., Thorold—Ontario Paper Co. Ltd., Allanburg Rd., has awarded the contract for sales, sulphite and plant building, also fire protection, sewers, and railroad track, to Aiken & MacLachlan, Ltd., 9 Queen St., St. Catharines. Estimated cost $300,000.

Ont., Welland—Joseph Stokes Rubber Co., Ltd., Bernard St., has awarded the contract for a 1 story, 72x152 ft. addition to its plant to W. C. Brennan Contracting Co., Ltd., 400 Gage Ave. W., Mamilton, at $46,000.

Que., Three Rivers—Canadian International Paper Co., Ltd., Sun Life Bldg., Montreal, plans alterations to its paper mill. Work will be done by owner. Estimated cost $365,000.